

news, knowledge, advice

SCIENCE DIGEST

JANUARY 1967 • 50 CENTS ICO

ELECTRIC CARS

a preview

Fly in one
weekend

Stay young
with ions

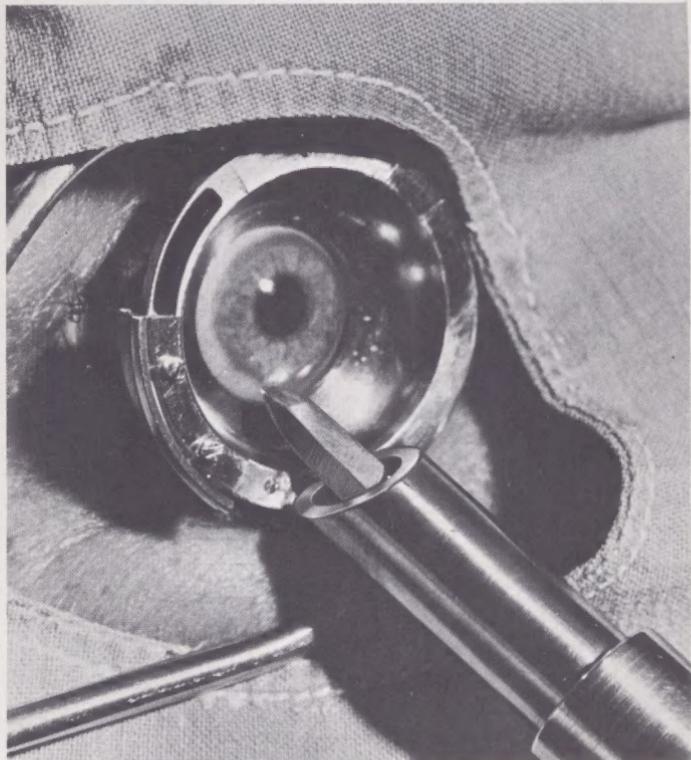
Tomorrow's
new foods

If you have
backache

Special report
**THE
CITY
IN
2000 A. D.**



Nature in your back yard



New knife for eyes

A NEWLY developed diamond knife with a "fabulously sharp" cutting edge will make cataract and corneal transplant surgery easier. Dr. Davis G. Durham, an ophthalmologist, has developed a new technique in cataract surgery, based on a surgical knife with a microscopically perfect cutting edge that is made from gem-quality diamond. The ultra-sharp blade measures less than 100 Angstrom units in thickness at its edge, whereas a red blood cell is 80,000 Angstrom units in width. The advantages of such a smooth, sharp blade is its ability to make a beveled incision. The knife is so precise it can make a million cuts in a half-inch strand of hair. Says Dr. Durham, "You encounter no resistance while cutting. Consequently, extreme care must be exercised." The doctor developed a vacuum ring that fixates the eye and positions the knife properly during the transplant operation.

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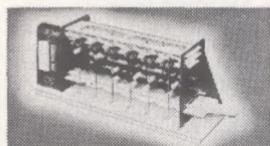
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HAPPY New Year! And Happy New Decade! This is the first issue of our 31st year. To celebrate the occasion, we come to you in a spruced-up cover and introduce the first of a series of innovations and improvements you'll be seeing for a number of months to come.

The big change appears in the special section in the center of the magazine—the one in this issue, devoted to City Planning.

THIS MONTH

Each month, we will offer a special report on a broad subject of current scientific interest. The reports will not be just long articles. You'll get a rundown on the state of the art, panels and boxes on special applications, projections of current research, picture reports, and other features—all aimed at this purpose:

To provide a report with solid usefulness to fill you in quickly, yet comprehensively, on each of the areas in which science today is moving so fast.

In future issues, too, we plan to bring you more news about what's happening in science and more material to explain the news and show you how to use it.

Maybe you've noticed that, beginning this month, the following line appears above our name: "News, knowledge, advice." To bring you these each month from the world of science is our mission.

—THE EDITORS

news, knowledge, advice

SCIENCE

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DIGEST

Melody Norsgaard is a lucky girl. She has a unique opportunity to study nature within sight of the concrete towers of Manhattan. See "Nature in Your Back Yard," starting on page 79.

CBS-TV photo



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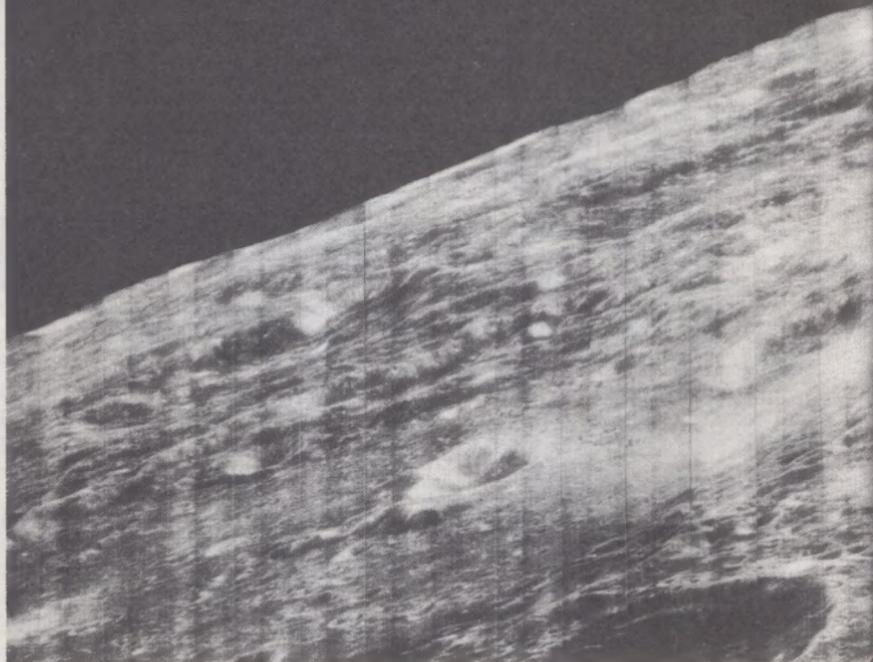
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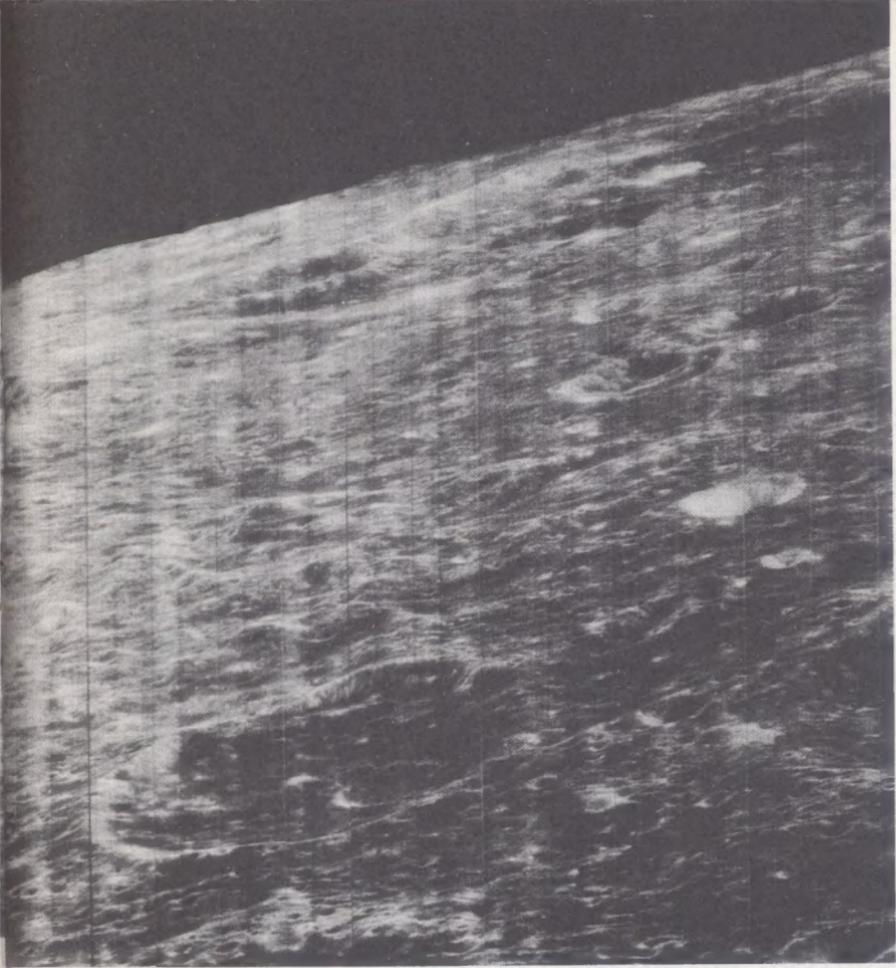
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THE LATE SCIENCE NEWS



OUR EVOLVING MOON. The above photo of the "tormented surface" of the hidden side of the moon, shot by our Lunar Orbiter space-craft, is taken by scientists as one indication that the moon is still evolving. Film from the craft has shown that the moon is not a cold, dead, lifeless place, but a body "very nearly as dynamic as the earth." Now scientists believe that only a small number of the moon's craters were formed by meteorite bombardments the majority were created by volcanic eruptions. Some structures may have been formed a mere 100,000 years ago.



FINE FINISH. The Gemini program ended so smoothly that it seemed as if spaceflight has become almost routine. There were only minor mishaps during the flight of Gemini 12 and a number of major successes. Astronaut Edwin E. Aldrin Jr.'s extended space "walks" proved that man can work in outer space if he is properly equipped and trained. Other spacemen suffered from excessive fatigue trying to work outside of their ships. The secret seems to be providing handholds and footholds so energy need not be expended getting into position.

LIVELY MARS? New studies of the atmosphere of Mars have again raised hopes of finding life there. Spectroscopic studies indicate that the Martian atmosphere abounds in hydrogen compounds. Hydrogen compounds are considered necessary to life. The discovery of hydrogen was a great surprise since the planet's gravity was believed to be too weak to hold hydrogen in any quantity.

UFO PROGRESS. Dr. Edward U. Condon, head of the U. of Colorado-Air Force study of flying saucers, said that his project was getting "good acceptance" in the academic world. "There is no tendency to ridicule the project at that level". . . . The National Investigations Committee on Aerial Phenomena, a private UFO group announced that its membership had doubled in the last year. . . . Maj. Hector Quintanella, director of Project Blue Book, which keeps track of UFO's for the Air Force said that the total number of sightings in 1966 vastly exceeded the number in 1965.

DOUBTFUL SCIENTIST. Dr. Jesse L. Greenstein, professor of astrophysics at Caltech said that thoughts of interstellar travel were "pure fantasy". He was even skeptical about communicating with other civilizations in space. "If the nearest civilization were 10,000 light years away --a reasonable assumption--then we would need an aerial as large as the earth to catch its signals. . . . For lack of communications power we may have to live in happy ignorance of our future evolution and fate". However, he still urged more work in interstellar communications.

LIGHTS OUT. After studying the Northeast power failure for about a year the Federal Power Commission said that it could happen again. The FPC noted many steps had been taken to make such failures "less likely". But the commission expressed its "greatest concern" over the continuing unreadiness of individual utilities "to take, positive and timely actions. . ."

BURNED UP. A House investigating committee found that electric light bulbs lasted longer 50 years ago. Chairman Jack Brooks (D-Tex.) charged that the life of an average bulb could be doubled at little extra cost to the householder. Today's bulbs are "a nuisance and a hazard" the report said.

CHINESE A-MISSILE. The U.S. confirmed that the Chinese Communists fired a missile about 400 miles and that it carried an atomic warhead about the size of the Hiroshima bomb. The test was no great surprise but it seemed to indicate that the Chinese are moving faster than expected. Their atomic development is now on a par with the French although they started later.

SOVIET ANTIMISSILE. For several years now the Russians have been saying that they have developed an antimissile system. For a long time no one took these statements seriously, but recently Defense Sec. Robert McNamara said there was "considerable evidence" that they had done just that. McNamara said the Administration would probably recommend that the U.S. build a more sophisticated missile to penetrate the newly deployed Soviet defenses.

NEW VACCINES. A live virus vaccine against mumps may become available this year and a vaccine against German measles or rubella may be ready for use before another major epidemic of the disease occurs.

RABIES VACCINE. Canadian researchers are testing a new and safer anti-rabies vaccine. The new vaccine is designed to eliminate the bad, sometimes fatal reactions occasionally suffered by patients given the conventional treatment. A new U.S. rabies vaccine is also being tested by researchers in Philadelphia.

ANOTHER SMOKING DANGER. A New Orleans study has established a relationship between cigarette smoking and hardening of the arteries in the heart. Previously smoking had only been implicated as a cause of acute heart attacks but had not been related to the more gradual heart ailments.

SALT FOR BURNS. Solutions made up mainly of common table salt may replace plasma in transfusions as a treatment for severe burns. Doctors specializing in burn treatments found the solutions cheaper, better.

SAFE DRINKERS. Drivers who have had one drink have fewer accidents than those who have drunk no alcohol at all. This was one finding of a study carried out under a grant from the liquor industry. Industry spokesmen suggested that the tranquilizing effects of alcohol relieved the anxiety of driving. The researcher who conducted the study, however, disputed this view and said no firm conclusions could be drawn.



REPORT OF THE MONTH

New General Motors entry in electric car sweepstakes is experimental Electrovair II, photographed at recent showing. Huge silver-zinc battery pack offers speed, short range.

Electric cars — a preview

by Hubert Pryor

I CLIMBED in next to the driver. He turned the "ignition" key and a green light on the dash went on. Next to it, he moved a lever down from N to D. Nothing happened. Then he pressed his foot on the "gas" pedal.

The blue, six-seater sedan eased forward with a hum. Quickly, it gathered speed. My spine sank into the back of the seat with the surge of power. The hum rose in pitch to a soft, turbine-like whine.

But I had to strain to catch it. In 16 seconds, we were going 60 miles an hour and about all I could hear was the rush of the wind.

So went one recent preview—by General Motors—of an experience

that some day may be a daily one in the lives of millions of people.

The big news in transportation today is: The electric automobile is back. You can't yet go into a showroom and buy one. But it is back—on the drawing board, in the lab, in the engineering shop, on the test track.

Old Detroit hands, hardened by years of empty talk by supporters of the electrics, squint their eyes at talk of any imminent changeover. And you know they're right as you look at the vast, sprawling automobile plants on the city's outskirts—plants tooled up to produce each year millions upon millions of gasoline-engine cars.

But the talk is different this time. It comes from Detroit itself, from

the "bigs" of the business—GM, Ford and Chrysler.

True, as you cock an ear to all the talk of the new electrics, you seem to hear two voices. One says, "Look at this great drive we're making to produce electric automobiles." Another declares, "Of course, they're a long way off. We don't even know if they're practicable."

The seeming dichotomy stems perhaps from the new political expediency of working on pollution-free vehicles, while necessarily continuing to produce the cars that are the industry's bread and butter.

A few days after the Ford Motor Company announced its new battery for powering cars, I was one of several editors and writers who questioned Henry Ford II about the prospects of electrics. He sounded almost negative:

"All we have is this new battery concept," he said. "We still have to build an automobile."

At the GM showing more recent-

What makes them hum?

GM's recent showing of electric vehicles proved how quiet they are. They just hum. The hum is caused by rapidly expanding and contracting flexible coils used in commutating circuits in the inverter, the mechanism that changes the batteries' DC current to the AC needed for the motor. When the cars are standing with the "ignition" on, all you hear is a barely audible whirr. That comes from a blower used to cool the semiconductor devices for car's current.

ly, I also asked GM executive vice-president Edward N. Cole about the electric's prospects. "We haven't seen any interest," he said, "except in golfcart-type vehicles."

Both Ford and Cole admitted they hadn't probed the prospects much. Ford said his company had conducted no market research on potential consumer demand. Cole said GM has not done market research "to the extent that we should."

Both also stressed the laboratory and engineering work still to be done before the world can expect anything bigger than miniature cars that operate on electricity.

There's no doubt that the work is considerable. The big snag is to produce a way of generating or storing electricity in a vehicle so that the power produced will drive it reasonably far and reasonably fast without imposing a huge load of weight on it.

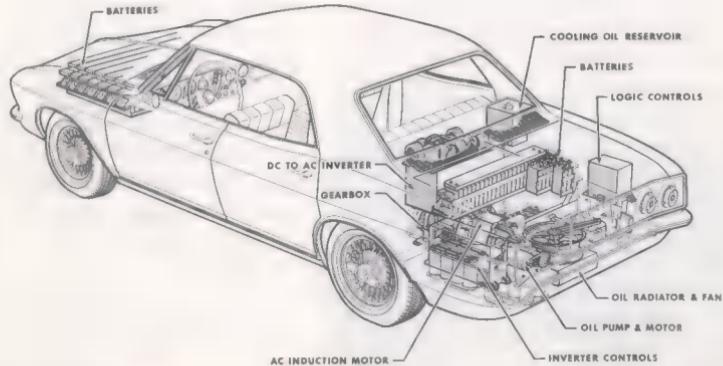
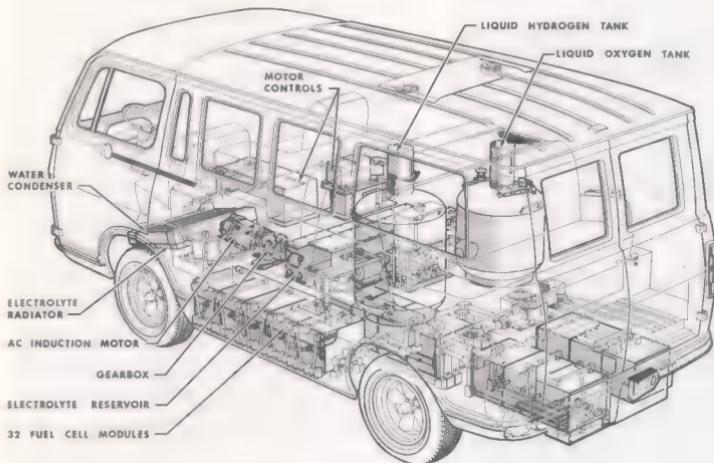
For instance, up to 3,000 pounds of lead-acid batteries of the kind found in gasoline cars would be needed to equal the power of a 600-pound piston engine.

A silver-zinc battery system, however, would have to weigh up to 1,100 pounds to equal the power of a 600-pound gasoline motor.

That's the battery system GM uses in the sedan it recently exhibited. Yet even it is impracticable, as GM readily admits. It is almost prohibitively expensive, it needs recharging after 40 to 80 miles and it wears out after 100 recharges.

GM used silver-zinc batteries in

Second GM experimental electric car (right) is powered by fuel cell. Vehicle is converted GMC van. It carries liquid oxygen and hydrogen in tanks (cutaway diagram below), which generate power by chemical interaction. System requires complex of auxiliary devices which engineers are working to simplify. Car is dangerous because of fuels used, but safer fuels, including gasoline, are foreseen. The Electrovair II (cutaway diagram at bottom) must contend with power train weight of 3,650 pounds. Car also has inverter-modulator with elaborate high-power switches, and a signal box to activate them properly.



the test passenger vehicle it displayed because they deliver high peak power and store energy efficiently. The Electrovaïr II, as the car is called, is an electric version of the Corvair automobile and has practically identical performance characteristics—except for range.

The car is an impressive engineering feat, but it is really nothing but a curiosity to the consumer. It would be ridiculous economically to go into production with it.

To engineers, however, such experimental cars are vital. In the Electrovaïr, they have what they call "a test bed for motor and control development." It performs as well as it does, in fact, largely because of an even earlier experimental model, called Electrovaïr I.

Acknowledging the limitations of the silver-zinc battery system, GM has its sights set today on two others: an oxygen-hydrogen fuel cell and a lithium-chlorine fuel cell.

Both these systems, of course, involve, not only storing electricity in a car, but also generating it, by chemical interaction.

The lithium-chlorine fuel cell, a high-temperature molten metal

Ford's Neil Weber (l), Joseph T. Kummer developed company's new type battery cell.

variety, is being worked on by GM's Allison Division and the Defense Research Laboratories, Santa Barbara, Calif. But temperatures of up to 1,200 degrees F present such problems that GM indicates no optimism about the system's future.

Apparently, it's more optimistic about the oxygen-hydrogen fuel cell, for its recent showing of electric-vehicle engineering included a Rube Goldberg-type of contraption embodying just such a system to power a full-sized GMC van called a "Handibus."

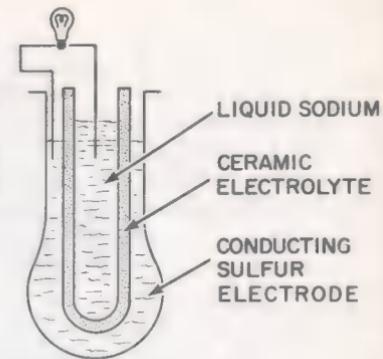
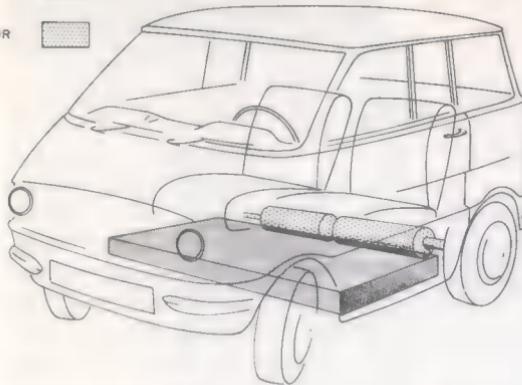
Between the second and third rows of seats, engineers had installed two spherical tanks of hydrogen and one of oxygen. The vehicle, called an Electrovan, presented a potential fire hazard and visitors were not invited to ride in it. But it passed in review at a lively clip, humming loudly enough for one to hear as it zipped by.

The vehicle was outdated even as it was displayed. Robert A. Charpie, president of Union Carbide's electronic division, which made the power system, told me that his company already has a fuel cell system that operates on air instead of oxygen and is twice as efficient.

Charpie added that fuel-cell technology is moving almost incredibly fast, in terms of both safety and efficiency. Some day, he said, there may be fuel cells that operate on gasoline.

While GM is working on electric cars designed for fast-moving expressway driving in urban areas,





Ford with its British subsidiary is engineering this low-cost, subcompact electric, called City-Car. It's also perfecting new high-performance battery system shown at right.

Ford seems to be aiming at an intermediate market.

It announced recently that it will test a prototype electric car in 1967. Made by Ford of Britain, the vehicle will be a sub-compact, meaning it'll be smaller than a Falcon but larger than a golf cart. It will have room for two adults and two children. It will be called a City-Car.

Again, as in the case of GM's entries, the size is a compromise—leaning in Ford's case to a smaller vehicle requiring a lighter, less expensive power system.

Regular, commercially-available batteries will power the City-Car, but the "magic ingredient" in the Ford car eventually is likely to be a revolutionary battery concept announced a few weeks before the GM show.

The Ford Motor Company announcement called the concept a "major breakthrough." Ford's battery uses sodium and sulfur with a "unique ceramic material" for the electrolyte.

"The heart of our new proprietary battery system," said Michael

Ference, Jr., Ford vice-president for scientific research, "is a crystalline ceramic composed of aluminum oxide and based on a material known as beta-alumina. This material selectively passes sodium ions while containing all other liquids, including liquid sodium and sulfur."

The materials used, Ference added, are "inexpensive, plentiful and light in weight."

The battery cell displayed by Ford will be produced in a larger size during the coming year, and next year will be increased in size to a unit weighing from 50 to 100 pounds that will deliver from five to

Why electric automobiles?

Says Lawrence R. Hafstad, vice-president in charge of General Motors' research laboratories: "The incentives for continued research are real, for they include: Quiet operation; efficiency not limited by heat engine cycle; potentially emission-free operation; use of low-cost electricity generated by nuclear reactors when fossil fuels are more scarce."

10 kilowatts. A system of sodium-sulfur batteries weighing 500 pounds would give a Falcon a range of 134 miles at 40 mph.

Because the reactants are liquid and the solid electrolyte is inert, the battery is almost deterioration-proof.

Ference said the system "promises to meet the over-all needs of an efficient, low-cost, compact, urban-suburban electric vehicle requiring only overnight recharging."

Chrysler Corporation also is doing research in electric cars on this side of the ocean.

In Britain, *Science Digest* has learned, the manufacturers of a tiny two-seater electric car called Scamp (see September, 1966, issue) are now tooling up to produce the car for the general market.

Electric-car technology in the immediate future, most experts agree, is going to change fast, presumably for the better. In other words, if you want an electric car, you're not going to have to settle for a glorified golf cart with inefficient (weight-to-power) lead-zinc batteries.

Automobile engineers today are looking at new developments in space and military research to bring about power sources that are compact and economical.

In the meantime, they're working on ways to reduce pollutant emission by gasoline piston engines. GM's Coleman says, "I am confident that progress in reducing or controlling hydrocarbon emissions will continue to accelerate greatly."

in the years immediately ahead."

The best guess is that the first of the new commercially successful electric cars will be vehicles for use in and around one's community—for shopping, taking the children to school, commuting to work. Piston-engine cars will be preferred for most other types of driving—until better battery or fuel-cell systems are developed.

Arjay Miller, president of Ford, says his company hopes to have a commercially available electric car by 1971. GM's Cole says his company doesn't set a date, although he believes it will be 10 to 15 years before an electrically powered "modern passenger car" is available.

He adds:

"But we're going right ahead with our own work. We don't see anything at the moment that we should exclude."



"Who am I? Where am I?
What century is it?"



Psychiatry takes to computers

by Flora Rheta Schreiber
and Melvin Herman

THE hospital admission note read: "THE PATIENT IS A FIFTY-SIX-YEAR-OLD MALE, WHO LOOKS HIS AGE, APPEARS TO BE IN NORMAL PHYSICAL HEALTH, AND OF A PREDOMINANTLY MESOMORPHIC BUILD. HE HAS NO PHYSICAL DEFORMITY. THE FACIAL EXPRESSION OF THE PATIENT IS TEARFUL, WHILE HIS DRESS IS METICULOUS.

"HIS GENERAL BEHAVIOR AND ACTIVITY WERE MODERATELY AGGRESSIVE AND MARKEDLY AGITATED. THE EFFECT IS ONE OF MODERATE HOSTILITY AND MARKED DEPRESSION. THERE IS ASSOCIATED MODERATE SUICIDAL PREOCCUPATION."

Does that sound like the writing

style of a precise, almost literary, doctor? Well, a doctor made the observations by filling in the appropriate spaces on a form, but he didn't write a word. It's a sample of the narrative style of a computer.

Since the fall of 1964, a computer has been used at the Institute of Living in Hartford, Connecticut. Dr. Bernard C. Glueck, Jr., Research Director at the Institute, reported recently that the computer helps at many levels, at the simplest, by recording, recalling and correlating more information about

Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric Hospitals.

patients than was ever possible before.

With the information supplied to the computer, it can come back with a prediction of a course of illness for a patient where certain findings have been recorded and give the type of treatment that probably will be the most successful. For example, Dr. Glueck says, "We can ask of the computer, Which things will work best with this particular patient? We will get, in declining order of probable success, the names of several drugs. This is based on the experience with patients with similar behavioral profiles that we have fed into the computer. "But," he adds, "you must keep in mind that what these computerized data yield is only a probability—not a sure-fire 'this is it' type of answer. The machine is not omnipotent, and one thing the staff has had to learn is that while it works efficiently in nearly every case, it does not work in every case given it."

Reduces paper work

But a computer of course can search the files and lay all the relevant material for a very large number of patients in front of a doctor or the medical staff in a matter of seconds. Another time saver is the great reduction of paper work in preparing this comprehensive record. All the time gained can be given to the patient.

A report of the work in the Institute published for clinically minded

Computers promise universal standards of psychiatric terms.

psychiatrists in *Frontiers of Hospital Psychiatry* says of the computer, "It describes in detail the patient's state on admission, last week, yesterday, his medication at every point, compares him with other patients, with normal persons —thereby aiding diagnostic accuracy—and turns all this into graphs and charts that make this data dramatically useful."

Another substantial gain in the direction of better patient care has come about through the use of computerized nursing notes. The doctors get this information in graphs and charts as well as in narrative form. Still a greater gain has come in improved communication of physicians with nurses and other staff members. Now that all are using the same form, the terms have been standardized and, for the first time, they are talking a common language regarding the patient.

The Institute, in fact, started its computer work with the nursing notes. Nurses are always required to make notes concerning patients, but they are often sketchy and are frequently overlooked by the psychiatrist. Yet the nurse spends quite a bit of time with the patient and her notes can be very valuable, particularly in describing behavior the psychiatrist is not present to see. Now the nurse has a system of

recording her observations that lends itself to good reporting. A record is made daily for every patient before the nurse's shift ends and the report is ready for the next shift to utilize. For every 24 hours of the patient's hospital life, a chart is made by the computer, showing changes and the degree of change noted by the nurses. Nurses may add comments by writing them in.

The computer makes possible immediate day-by-day comparison of each patient. It also performs factor analyses, by grouping significant material.

Unusual behavior patterns show up in the computer-analyzed nurses' notes more readily than they do in the traditional system. The difference is apparent at the Institute because some wards do not use the computer system.

The Department of Education-Therapy also makes a computerized report. In this way, the doctor has an analyzed report on every activity his patient attends.

Frontiers of Hospital Psychiatry quotes Dr. John Donnelly, psychiatrist-in-chief of the Institute, as saying: "I remember the anxieties this program raised in our staff, including those at the top levels. Many fears were expressed. Some were fearful that this would impair the doctor-patient relationship—that everything would become mechanical, that the doctor would become less important in the treatment of patients, that the machine would make the decision."

The Institute staff has decided

that objective observation is the key to understanding the patient. And the computerized record contains only behavior that can be described objectively.

One important development psychiatrists look to the computer-based data processing system for is universal standardization, so that behavior described anywhere in the world may be compared. A few years ago, a celebrated psychiatrist from England listening to a full-day discussion of mental patients in the United States said that one thing was clear to him. The patient described and labelled often was a very different animal from the one bearing the same label where he came from.

Universal language

Obtaining universal agreement in description is a problem being tackled by Eugene Laska, a Ph.D. who is the director of the Computer Laboratory at Rockland State Hospital, New York, and Dr. George Simpson, a psychiatrist, who is Director of Research at the same hospital. They designed the computer language quoted in the opening paragraph of this article. They call their language "Novel." It's written by the computer after scanning marked forms. They also have devised a computer language they call "Scribe."

Scribe is multi-lingual. The results of a psychiatrists' examination—in Spanish, French or any language at all—are recorded on a

punch card. The cards can be programmed to produce a narrative in English or again in any other language.

More precision is expected as well as cross cultural comparison. "International use should bring to light cultural differences that might otherwise be overlooked," says Dr. Laska. "The language can be used the world over."

Drs. Simpson and Laska hope that it will be. Right now they are concentrating their efforts at Rockland State and in doing drug evaluation studies in a number of hospitals in the region. They are collecting the kinds of information about drugs that are usually lost. As Dr. Laska told us, "The overworked psychiatrist wants to assist in research by making the clinical histories of his patients available. But he rarely has the time to fill out the elaborate forms necessary to participate in a research project. Even if the clinician does join a study, or a search is made through progress notes written into the patient record, he often omits material that is not too relevant to him in his treatment but is crucial to the research project. The standardized system makes sure that he'll get all the data, and he can do it without taking time from the patient."

This will mean that a report of every patient in the hospital will get into the studies record. When this record becomes extensive, it will mean a new assurance in drug prescription for the mentally ill patient. A doctor, for example, has

Instant reports on drugs' effects will permit more accurate prescriptions.

found that a particular patient has not been responding to the drug he placed him on. Another drug is indicated, the doctor concludes. The hospital stocks a new drug he's read about but never used. He talks it over with the doctors on the hospital staff who've used it but is told they don't feel they've been using it long enough to suggest it for his patient. In a pre-computer era, he would have had to wait a year or more for some investigator to run a lengthy study, write it up and wait another year for it to be published in a scientific journal. However, as soon as the data-processing system is ready, the doctor will have only to pick up his telephone and ask, "How is the drug working with such and such a type of patient?" Within minutes, he'll get a report on the day-by-day experiences reported by clinicians working in hospitals all over the country and it will be accurate information, for from the physicians' reports the computer can weave all strands of information.

The system can work in evaluating treatment for patients as well. Rockland State is using it to give a longitudinal picture of the patient from the day of admission through the many changes he undergoes during his stay in the hospital.

Dr. Laska gave us a glimpse into some of the less intricate problems

involved in creating a style for the computer to make it possible to note psychiatric information. Take the simple problem of handling pronouns. At the beginning of the record, the sex of the patient is recorded in the normal process. Then the computer is programmed so that each time it has to make a decision about a personal pronoun, it goes back to this area, called simply the address, to retrieve the proper word.

Consider a sentence: "The patient ate his breakfast, went for a walk, played volley ball and attended occupational therapy." The computer keeps count. If only one thing is mentioned a period is printed. "He ate breakfast." If there are two, the computer separates them with an "and." If there are three or more, the computer places commas where needed and an "and" in place before the last item. You get a kind of Hemingway style with the lack of emphasis on any of the various items of a series. The computer's vital emphasis comes in plucking from notes and reports the significant pieces of information as they are requested and placing them dramatically before the doctor. The computer helps by correlating the vast information and storing it usefully.

Now much more can be known about the patient than ever before. But it's the doctor, and not the computer, who treats the patient. The doctor released from the bondage of paper work is capable of greater medical creativity.

Russians Learn While Asleep

(WE KNEW IT ALL THE TIME)

News items appearing in newspapers and magazines throughout the nation report that: "In the Kiev State University, a woman student mastered a complete course in English in 28 nights."

"A philologist at the Ukrainian Academy of Science says that sleep-learning is less tiring to the brain than normal learning."

This "new" Russian discovery has been in use for over 2,000 years. In the United States sleep learning has been actively used since 1922 when Chief Radioman J. N. Phinney of the U.S. Navy successfully taught Continental Code during sleep. Since then, the use of sleep as a time for learning every kind of material, has become a reliable and accepted addition to our learning programs. The technique of sleep learning is being used by professionals, students and instructors, sales and corporate executives, housewives and mothers . . . along with many personalities in the public eye such as: Jan Sterling, José Ferrer, Red Buttons, Efrem Zimbalist, Jr., Sam Wanamaker . . . and many others — who use the time of sleep to absorb information effortlessly and painlessly for instant recall when awake.

To acquaint the readers of this newspaper with the simple techniques that allow constructive use of your sleeping hours, the Self-Development Research Foundation, a leading researcher in the field of learning while asleep, has published a compilation of Research Studies. These easy to understand reports tell you how to absorb any material while you sleep. Learn languages; learn to relax and control tensions; control your weight; sharpen your memory; develop your sales ability — all while you sleep, and without losing your rest.

This 26 page report is yours free. No obligation and no one will call. Simply enclose a dime to cover cost of postage and handling. Send your name and address to: Self-Development Research Foundation, Dept. Y-30, 207 East 37th Street, New York, New York 10016. Please include your ZIP CODE.

WONDER OF THE MONTH

Looking for the 'Monster'

by Daniel Cohen

Is Scotland's fabled Loch Ness Monster some form of giant sea slug? Dr. Roy P. Mackal of the Department of Biochemistry of the University of Chicago thinks it just may be.

Dr. Mackal is a member of The Loch Ness Phenomena Investigation Bureau Limited (LNPIB), a group dedicated to solving the mystery of the strange things that have been seen at the Loch. Members of the group spend their summers scanning the waters of this Scottish Highland lake, hoping to catch sight of, and more importantly to photograph, the creature, if indeed there is a creature. This year, for the first time, the group is keeping at least one man at the Loch the year 'round hoping to detect signs of the elusive beast in the winter.

So far, the results have been unimpressive. Plagued by bad weather and hampered by a chronic lack of funds to conduct extensive experiments, or even buy advanced photographic equipment, the LNPIB has had to settle for some fuzzy photos of an indefinable object taken at a great distance.

But because of the prestige of the members of the LNPIB (one is a former Member of Parliament), the

group was able to get the Joint Air Reconnaissance Intelligence Centre of the Royal Air Force to examine some motion pictures, purported to be of the Monster taken in 1960 by Monster enthusiast Tim Dinsdale.

The report issued by the RAF's photographic interpretation experts was mildly sensational, and it was supposed to be secret. Minister of Defense for the RAF Lord Shackleton wrote at the time, "We would not wish to find the Ministry of Defense taking sides in a first-class public argument about the possible nature of the underwater population of Loch Ness." But inevitably word of the findings leaked out, and the report was made public.

Dinsdale's films themselves had never been a secret. On the contrary, they had been widely shown on British television. But to the untrained eye, they proved little. All one could see was a dark triangular shape moving across the water very far away. Maurice Burton, a biologist who had studied the Monster problem for years and become progressively less and less sure that there really was a large unknown animal living in the Loch, thought the pictures just showed a distant motor boat.

The RAF's cautiously worded conclusion was that the object Dinsdale photographed "probably



KPS

On the shores of Scotland's Loch Ness, investigators await appearance of "the Monster." Usually sightings are indistinct, photographs even worse. The picture at right, taken in 1934, is fairly typical. Something is moving through the water, but what is it?

is an animate object." The cross section of the object would "be NOT LESS than six ft. wide and five ft. high," with about a three-foot "hump" sticking above the surface. Length was much harder to determine, since the object seemed to be going almost directly away from the camera. But the report notes that a total length of 92 feet might be possible. This is a far greater estimate than usually given for the Monster. Most people who claim to have seen it give the length as between 40 and 60 feet.

In addition, the RAF experts thought the "object" moving across the water at 10 mph, considerably faster than most conventional small craft.

Said Lord Shackleton, "I have always disbelieved in the Monster. Now I am even more mystified than ever. But I find it difficult to discount the findings of this report."

Stories of a "fearsome beastly" in the Loch go back 1,500 years. But until 1933, they were considered traditional folklore. In that year, a road was built around Loch Ness, and the rush of modern sightings began. Some think the blasting for the road disturbed the creature and drove it to the surface, others be-

lieve that the road simply made the Loch more accessible to watchers. Whatever the reason, over 3,000 sightings have been reported in the last 34 years. In addition, numerous photos have been taken. None of the pictures actually shows any type of animal clearly, so the guessing game of what the Monster may be continues.

Dr. Mackal's suggestion of a giant sea slug is not as odd as it first sounds. Admittedly no known sea slug measures over a foot, but the sea slug is a mollusk, and a near relative of the squid. A little over a century ago, sailors and fishermen reported encounters with giant squids. However, the only squids known to science at the time were quite small and few took the sailors' reports seriously. Finally when the bodies of enormous squids were found washed up on shore and the creatures were trapped in nets, their existence was officially recognized. These monsters can attain lengths of 60 feet or more and weigh over a ton. So the thought of a giant sea slug is not entirely inconceivable.

If the sightings in Loch Ness are caused by a gigantic mollusk then a number of puzzles can be solved. There is the matter of "humps."

Doomed By Your Memory?

A noted publisher in Chicago reports there is a simple technique for acquiring a powerful memory which can pay you real dividends in both business and social advancement and works like magic to give you added poise, necessary self-confidence and greater popularity.

According to this publisher, many people do not realize how much they could influence others simply by remembering accurately everything they see, hear, or read. Whether in business, at social functions or even in casual conversations with new acquaintances, there are ways in which you can dominate each situation by your ability to remember.

To acquaint the readers of this publication with the easy-to-follow rules for developing skill in remembering anything you choose to remember, the publishers have printed full details of their self-training method in a new book, "Adventures in Memory," which will be mailed free to anyone who requests it. No obligation. Send your name, address, and zip code to: Memory Studies, 835 Diversey Parkway, Dept. 690-011, Chicago, Ill. 60614. A postcard will do.

Most sightings report that the creature has anywhere from one to seven or more humps sticking above the surface of the water. If the Monster is a vertebrate (whether reptile or mammal) as commonly thought, then this variable number of humps is hard to explain, but the change would present little problem to a squishy, backboneless sea slug.

The Monster has been reported on shore a few times, but these reports might be mistakes. If the creature were an air-breathing mammal or reptile, it could come ashore quite often, or if, like a whale, it were entirely aquatic, it would at least spend much of its time on the surface. A slug breathing through gills would spend almost all of its time underwater as the Monster seems to.

Known sea slugs span quite a range of shapes. Dr. Mackal says that some have the snake-like neck and small head often reported in Monster sightings. They can also have appendages that look like flippers, another feature of some sightings. Also some sea slugs move by expelling water, in a sort of underwater jet propulsion. This could account for the high speed and considerable turbulence often associated with the Monster.

Of course, as Dr. Mackal himself is the first to admit, all this is pure speculation. But he hopes that if his group gets enough money for equipment, they will be able to photograph the monster up close, or possibly even catch it. In any event, they will keep watching.

INVENTOR OF THE MONTH

Ultra sound for dentistry



By applying ultra high frequency vibrations, a Long Island research scientist has succeeded in bonding metal to human dental enamel. The welding feat has won for Dr. Robert Hoffman (above) praise in the professional press, an international award, and U.S. Patent No. 3,279,067.

The *Science Digest* Inventor of the Month is on the staff of the Waldemar Medical Research Foundation at Woodbury, and has his own dental practice at Merrick.

The ultrasonic energy method is the first, so far as Dr. Hoffman knows, to effect a direct bond. Adhesives have long been tried, but have never proved satisfactory.

In a specific example, a strip of aluminum wire has been fastened to

a tooth by pressure from a vibrating tool operated by an ultrasonic generator at about 60 kilocycles. The bonding, which has high shear strength, is described in the patent as chemical.

Early uses in dental practice are expected to be in stabilizing teeth or in moving them and fastening them in new positions. The laboratory work has been with pulled teeth, but Dr. Hoffman does not think that the welding of those still in the mouth will be painful.

The inventor has bonded metal also to dentin, the material that constitutes the body of a tooth, and plans to try it with cementum, the hard layer around the root.

Dr. Hoffman has experimented with gold and silver, as well as aluminum. The foundation, in a statement, raised "the possibility that an entirely new spectrum of materials may be bonded to hard biologic structures," bones as well as teeth.

The International Dental Federation, will present Dr. Hoffman the highest award in dental research, the Albert Joachim International Prize.

After getting degrees from Colgate University and the New York University College of Dentistry, Dr. Hoffman served as an Air Force officer. He has been active in promoting the health of children's teeth.

—Stacy V. Jones

INVENTIONS PATENTS PROCESSES

New way to desalt water

A NEW way of obtaining fresh water from the sea may be practicable before long if the "Cornell Process" of desalinization is refined sufficiently to permit production of larger quantities of water. Improvement of the process is the purpose of a \$95,988 U. S. grant awarded Cornell University's College of Engineering.

Tested successfully in a pilot plant at St. Petersburg, Fla., the Cornell method partly freezes water to give a slurry of salt-free ice suspended in brine. This slurry is produced by vaporizing liquid butane in a continuous crystallization step. The ice and brine then are separated in an operation in which the ice is washed free of salt water.

With this method, only 31 kilowatt hours of power are needed to obtain 1,000 gallons of fresh water. Engineers hope to reduce this energy consumption in order to expand the yield from the 35,000 gallons per day now produced in the Florida plant to 50 million gallons a day in future plants.

How proteins formed

Proteins are the basic building blocks of life. Most people have heard that before. But how did proteins come about? How on earth

did life begin, and is it beginning anywhere else in our galaxy?

Possible answers to these puzzles or at least road signs pointing in a definite direction have been the results of experiments conducted by two scientists of the Central Research Dep't. of the Monsanto Company, St. Louis. They are Drs. Clifford N. Matthews and Robert E. Moser.

Their studies demonstrated how proteins could be formed from hydrogen cyanide through solar reaction with other elements on earth without prior formation of amino acids, the chemical substances that make up protein. This hypothesis denies the popularly held view that amino acids originally formed from reactions between the sun and the earth's gaseous atmosphere. Scientists now dispute this theory on the ground that spontaneous formation of amino acids was not possible under conditions existing on primeval earth.

After the formation of proteins from hydrogen cyanide, the resulting protein-dominated layer of matter concentrated in the oceans.

"Today," says Dr. Matthews, "it is likely that such processes still are occurring on Jupiter and on the myriad other planets possessing atmospheres of methane and am-

monia, cosmic molecular precursors of hydrogen cyanide and life."

Beyond Jupiter

Two alternative methods of sending exploratory unmanned probes on outer-planet missions (beyond the planet Jupiter) have been proposed by Francis Narin, senior scientist of IIT Research Institute's Astro Sciences Center.

The first method is gravity-assisted ballistic flight. It would provide shorter flight times for fly-by missions than does the direct ballistic flight method used for all space vehicles launched thus far.

Direct ballistic flight boosts a vehicle out of earth's gravitational field with a chemical rocket. The craft then coasts to its target with midcourse corrections made by intermittent firing of small "aiming" rockets as the vehicle progresses.

With the gravity-assisted method, the gravitational field of an intermediate planet, usually Jupiter, is used to speed a spacecraft to its final destination.

Narin points out the such flights can be performed only in years when the gravity-assist planet and the target planet are in favorable positions with respect to each other and to earth.

The second method he proposes is the nuclear-electric low-thrust flight, particularly useful for orbiter missions when the high-velocity approach of the gravity-assisted technique would make orbiting difficult.

A vehicle is launched from earth

by a chemical rocket and propelled on its trip by a low-thrust nuclear engine. Though still in the design stage, the engine now being developed could operate for years on tiny amounts of fissionable fuel.

Estimated flight time for placing 500 pounds of communications and scientific instruments in circular orbit by nuclear-electric propulsion are four and a quarter years for Jupiter, five years for Saturn, six and two thirds years for Uranus and nine years or more for Neptune and Pluto.

Fly-by missions by gravity-assisted propulsion would take two years to Saturn, three years to Uranus and four and a half to Neptune.

Plastic fertility

A plastic pipe may revive millions of acres of unproductive farmland and convert them into fertile fields.



Plastic pipes are being laid underground to drain water from oversalinated land.

Developed by United Technology Center, a company known for its aerospace apparatus, the Techite pipe is being tested for its efficiency

in draining water from subsurface land in San Joaquin Valley, Calif. The high water table and excessive salinity in this area have made the land hostile to plant life and agriculturally unprofitable. A drainage system is clearly necessary to eliminate excess water and make the ground usable.

Efficient drainage of water depends upon openings in the pipe or the pipe being segmented so that water can seep in to be siphoned away. Techite pipe plastic mortar is reported to collect and channel ground water better than contemporary systems. It also resists corrosive effects of water, soil and sewage and its by-products, according to one UTC official. The high strength-to-weight ratio renders the pipe practically unbreakable under normal rough handling conditions.

Tracking animals

Nimbus 3, the weather satellite to be launched this year, may be used to stalk migrating animals. Of course, its primary work is to film clouds for more accurate weather forecasting, but since the satellite's tracking facilities have been broadened, the number of chores it is to perform has been upped.

The idea of space-tracking animals' migrations stems from the unusual spotting system used by Nimbus 3. Weather data will be picked up from remote stations by the satellite as it passes overhead. The data will then be processed and stored until the satellite disgorges its load of intelligence at a ground

collecting station. All this information on winds, tides, clouds will be radioed from transmitters on bobbing buoys or in inaccessible mountain huts.

If signals could be picked up from buoys, why not from the backs of animals?

So reasoned Dr. Archie Carr, a research professor in zoology at the Univ. of Florida, who has been trying for years to find out how sea turtles regularly travel and navigate so precisely the 1,200 miles from the coast of South America to tiny, five-mile-wide Ascension Island in the Atlantic. He decided that he could get vital information through transmitting devices attached unobtrusively to the bodies of the turtles.

How elephants roam and what effects burgeoning civilization has had on the lumbering creatures may also be explored by Nimbus 3.

Eventually, a miniature version of the current 26-pound transmitting may be secured to the limbs of migratory birds to trace their long flights.

Turbine train

A prototype gas turbine railroad train, currently being run back and forth over a 20-mile stretch between Ronkonkoma and Central Islip, N.Y., promises to streamline the efficiency and the costs of the beleaguered Long Island Railroad.

Built by Budd Company, the stainless steel passenger car is powered by twin 525 HP gas turbines designed by AiResearch Division of



Pure water from polluted

A new automatic water treatment plant provides a simple method of supplying potable water even from moderately polluted raw water supplies.

Water Boy, developed by Neptune MicroFLOC, Inc., Corvallis, Ore., has a capacity of 25,000 to 150,000 gallons per day. That's enough to supply water for small industries, communities, camps, parks, resorts or any aggregate of up to 1,500 people.

The plant is especially suited for use in remote areas because of mechanical and electrical simplicity. It filters efficiently with mixed media filters.

The plants are pre-assembled and tested at the factory. Once set up, they require minimum attention. Field installation needs only the preparation of a suitable level pad, and hookup to electric power, water intake and export lines. Compact size permits the plants to fit comfortably in small buildings with ceilings of standard height.

Recently, a water boy plant was placed in service at Rainier, Ore., to make up a serious water shortage in that city.

Garrett Corporation. The turbine jets are mounted under the car, at both ends and geared directly to the axles. There is no jet scream nor is there any noticeable vibration, just a surge of power as the train starts.

The prototype train surpasses in speed, acceleration and braking power the diesel equipment the railroad now uses. Though electrical trains are fast and accelerate and decelerate as efficiently as the turbine variety, they are more expensive to operate.

Within three years, says Dr. William J. Ronan, chairman of the Metropolitan Commuter Transportation Authority, use of the new turbine train along with the electrical trains could be expected to cut the 90-minute Ronkonkoma-Manhattan run to 45 minutes for the 90,000 commuters that travel it daily.

The demonstration project, which cost \$1,386,000, will be conducted until May, 1967, six days a week, 16 hours a day.

THE PROGRESS OF MEDICINE

How to keep an executive healthy

by Arthur J. Snider

It's true that he may eat, smoke and drink too much, but the overall health of the American executive is good. So says Dr. Harry J. Johnson, chairman of the medical board of the Life Extension Institute. And he proposes ways to make executives even healthier.

Dr. Johnson dispels several popular notions about the health of executives, including the one that they die earlier in life than those of lesser rank.

"He is not an unhealthy specimen sacrificing himself on the altar of success and dying prematurely for the glory of the company," he says. "After examining 25,000 top management people, we find Mr. Executive is an average healthy person with a better than average life expectancy."

However, executives lack overall fitness and stamina as a result of economic affluence and sedentary work.

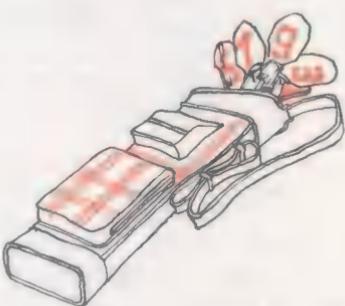
"When income is adequate to permit riding instead of walking, to allow eating, drinking and smoking without regard to expense, then physical fitness suffers. Add to this insufficient sleep because of multiple extra-curricular activities and we

have a way of life that lends itself to unfitness."

Other myths punctured by Dr. Johnson:

Myth No. 1—Most executives jeopardize their health by working under too much tension.

"Tension and pressure are essential to a full and productive life and are healthful unless continued too long," he said. "In a study completed recently, we found only 13 percent of 6,000 executives worked under tension that could be considered harmful to their health."



Myth No. 2—Executives are particularly prone to ulcers and coronary heart disease.

"There is no disease to which an executive is prone by virtue of his job," said Dr. Johnson. "There is no special hazard to being the boss."

Myth No. 3—"Relax, take it easy" is a good prescription for off-hours.

"Fifty years ago, men needed weekends and evenings to relax and rest physically," the physician said. "The usual work week was 48 hours and everybody's job involved considerable physical activity. But not any more. A larger proportion of leisure time should therefore be spent, not relaxing, but in some physical pursuit, such as a brisk, 15-minute walk three times a day, supplemented by golf, tennis or swimming on weekends."

Baldness facts

General health has little or no relation to the development of typical male baldness, says a dermatologist. There are three factors, however, known to be of great importance:

1. Heredity. The predisposition to baldness is an inherited trait. However, the inheritance of hair loss is a complex matter. It is not rare for it to skip one or more generations. The susceptibility to baldness may be inherited from either the father or mother.

2. Age. Loss of a certain amount of hair with advancing age is almost universal. It is the rare octogenarian who still has all the hair he had at 20. Men destined to show the greatest degree of baldness generally begin to lose hair in their late teens or early twenties. Even in the "worst" cases, the process is relatively gradual, taking a few years.

3. Male hormones. Several excellent studies of eunuchs have shown that such individuals will not become bald, regardless of age or hereditary predisposition.

"The typical pattern of common hair loss in men has often been ascribed to some deficiency in the blood supply or nutrition of the frontal and crown areas of the scalp," says Dr. Norman Orentreich, associate clinical professor of dermatology, New York University Postgraduate School.

"The basic error in all such theories is shown by transplantation experiments in which small plugs of scalp containing a few hair follicles are moved from one region to another. A small, circular, follicle-bearing full-thickness graft transplanted from the fringe area to the bald area in the same individual will heal very nicely and will show hair growth despite continued or even increased baldness all around it. We have observed such small grafts for periods up to 10 years without any loss of transplanted hairs. As these small grafts must obtain their blood supply and nutrition from the adjacent bald scalp, it is evident that this blood supply is more than adequate to support hair growth."

These grafting experiments have been modified into a surgical treatment for common baldness which can be used to restore a vanished hairline.

Apart from this, it is likely that any progress in the prevention or treatment of ordinary baldness will

be in the direction of blocking the hair-loss-triggering effect of male hormone without interfering with its other functions, says Dr. Orentreich.

Why Rome fell

From about 150 B.C., the aristocracy of the Roman Empire powdered their faces with lead, ate it in their food, drank it in their wine and breathed it in the air in their houses.



It was a fatal mistake. Failure to get the lead out marked the decline of the aristocrats, according to Dr. S. C. Gilfillan of the University of Chicago before the International Congress of Human Genetics.

The Roman poor escaped poisoning because their diet consisted largely of porridge eaten from pottery vessels.

Dr. Gilfillan said the completely new theory is the first to take into account archaeological studies of bone, lead pots, ancient cooking instructions and descriptions of Roman society.

"These show that the diet of the Roman upper class, after the introduction of Greek cookery and wine about 150 B.C., was full of lead. As a result, the Roman aristocracy of the imperial age had extraordinarily few surviving children and a high death rate. For 18 Roman generations all who could make, grab or marry money were left almost childless and replaced by the ablest drawn out of the poor."

In the Middle Ages, the nobility learned to avoid lead. As a result, they tended to survive, while the poor had a higher death rate.

Secrets of old age

The USSR Academy of Medical Sciences has examined 15,000 people over age 80 and reports a number of factors "which positively influence human longevity."

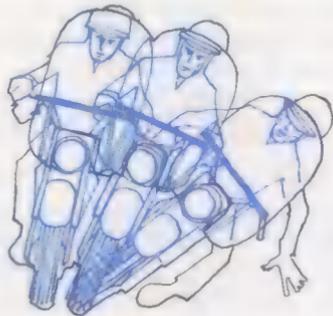
About 85 percent of the aged resided at altitudes of 500 to 1,500 meters above sea level. About 70 percent of parents, siblings and other close relatives lived to a ripe old age. Nearly all the aged were married. Over 90 percent of women had wed before age 25 and most became mothers before age 30. Most came from large families, as many as 18 to 20 children. About 60 percent of these old people still worked on farms, orchards and in their own plots. More than half were healthy, with no physical complaints. More than 50 percent retained normal sight and hearing.

Diets were of mixed foods with strong seasoning. They usually did

not smoke or drink except small quantities of home-prepared natural wines.

Motor-bike hazard

Motor-bike accidents are becoming a national epidemic, warns Dr. Robert C. Waltz, chairman of the trauma committee of the Academy of Medicine, Cleveland. Most of the injuries, he says, have the appearance of limb-shattering war injuries. Fractures are usually multiple, with bone fragments projecting through the skin.



Unlike the individual "packaged" within the steel framework of an automobile, the cyclist has no protective capsule. If he is an enlightened rider, Dr. Waltz points out, he may wear a safety helmet which reduces his chances of serious head injury, but his arms, legs, chest and abdomen are at the mercy of whatever he is thrown against.

"There are few minor motor-bike injuries," says Dr. Waltz.

In addition to a protective helmet, the surgeon recommends gog-

gles, gloves, boots, and a light-colored jacket and trousers so that the rider can be seen more easily.

'Cold' vaccines

Much more work needs to be done before the toll of acute respiratory illness can be reduced significantly by effective vaccines. Early promising results of the program, sponsored by the National Institute of Allergy and Infectious Diseases, are evidence that the program is not insoluble, however.

By the end of 1966, more than \$13 million will have been invested by the NIAID in the project which also involves seven drug firms and 21 other contractors serving primarily as evaluation centers.

Here are the results thus far:

- An experimental killed vaccine has been developed against primary atypical pneumonia, which strikes primarily young people, such as military trainees and college students living in large groups.
- A live oral vaccine against adenovirus-4, has passed its first field trial with 100 percent success at a military training camp. Adenovirus-4 and the other 30 members of the adenovirus family, cause acute respiratory tract infections. They are characterized by fever, sore throat, painful coughing and malaise. Hospitalization is often necessary.

- A trivalent vaccine, containing parainfluenza viruses types 1, 2 and 3, has been developed and seems to be effective.

How Fast Can You Read?

A noted publisher in Chicago reports there is a simple technique of rapid reading which should enable you to double your reading speed and yet retain much more. Most people do not realize how much they could increase their pleasure, success and income by reading faster and more accurately.

According to this publisher, anyone, regardless of his present reading skill, can use this simple technique to improve his reading ability to a remarkable degree. Whether reading stories, books, technical matter, it becomes possible to read sentences at a glance and entire pages in seconds with this method.

To acquaint the readers of this publication with the easy-to-follow rules for developing rapid reading skill, the company has printed full details of its interesting self-training method in a new booklet, "How to Read Faster and Retain More" mailed free to anyone who requests it. No obligation. Send your name, address and zip code to: Reading, 835 Di-versey Parkway, Dept. 690-011, Chicago, Ill. 60614. A postcard will do.

- The respiratory syncytial virus has been a problem. Although the virus causes a severe infection, it does not stimulate the production of enough antibodies to confer good immunity. An effort is being made to separate the virus into its components. By taking only the antibody-producing parts of the virus, it might be possible to make a safe, potent vaccine.

- A vaccine against the common cold is much further away chiefly because there are more than 70 rhinoviruses that would have to be incorporated into a vaccine. The Children's Hospital in Columbus, Ohio, has set up a rhinovirus reference typing center to lessen confusion in this crowded field.

Total hygiene

Sixty patients have been operated on at Bronx Municipal Hospital Center after being placed in a plastic isolator system for protection against outside bacteria and fungi.

Only sterile air, instruments, supplies and the surgeon's gloved hands are in contact with the wound. The isolator is hung like a shower curtain from a supporting framework which also supports the conduits for carrying cooled air and intercom cables. Helmet-jacket positions provide access for four to six surgeons and assistants.

Operations ranged from hernia repair to gall bladder removal, stomach, resection and hip fracture repair.

TIPS AND TRENDS

With expanding cities, country rats threaten to infect city rats with plague in ever larger numbers, causing explosive outbreaks among humans as during the Middle Ages.

Fluoridated water may help prevent severe hardening of the arteries. A Harvard study found fewer severe calcium deposits in the aorta among those drinking such water.

Older people are smoking less; youths, more. A Harvard study says anti-smoking programs among teen-agers should start before 15.

Check your decongestant cold tablets. They may contain phenylpropanolamine, found to drive some people temporarily insane.

Dairymen are worried about artificial milk. Made in California with a vegetable oil base, it undersells cow's milk 20¢ a gallon.

Aeronautics firms are developing design concepts for supersonic combustion ramjets for the Air Force. Despite their name, the idea for the engines envisions hypersonic speeds.

Watch that spray. Aerosol ingredients as well as the force of the spray, says Dr. Angus L. MacLean, may cause eye disorders.

A Senate study says one child in ten needs some kind of psychiatric treatment. Every year, two percent of those aged 10 to 17 are brought to court as delinquents.

THE SPACE PICTURE



Where gravity disappears

Left: To simulate weightlessness, space scientists have built a 510-foot deep shaft at Lewis Research Center. When an experiment is dropped down the shaft, it experiences five seconds of weightlessness.

Below: An autoclave, a sort of gigantic pressure cooker, is being readied to test a centrifuge "gondola" at Huntsville, Ala. The gondola was subjected to two times the pressure expected on the centrifuge.





Astronauts James A. Lovell, Jr., right, and Edwin E. Aldrin, Jr., were the crew for Gemini 12, final flight in the Gemini series. It was the second flight for Lovell making him the most travelled man in history. He has logged better than 7.3 million miles.

Rockets from Wallops Island, Va., were used to light up the sky during a series of recent tests. Photo shows luminous barium clouds released by two stage Nike-Tomahawk vehicle launched on Sept. 25. Photo was made five minutes after lift-off.





I see where they...

... are using a "flying laboratory" to photograph ICBM's as they re-enter the atmosphere. The "lab" (above) is a converted KC-135 jet tanker filled with more than \$3 million worth of cameras, photometers and cinespectographs. It's part of the Air Force's Ballistic Systems Division TRAP missile-tracking program.

The photo shows the array of equipment installed on specially designed three-axis gimbals. Data recorded is used to develop advanced ICBM warheads and aid the development of an antimissile system.

One of the cameras on board is a huge 70 mm Multidata camera which takes 60 frames ■ second. It works with a minimum of vibration. In place of an intermittent claw, the camera's film pulldown is accomplished by a set of reciprocating rollers that moves less than three-quarters of an inch in trans-

porting the film the required 2.34 inches.

First use of the equipment was made near Kwajalein Atoll in the mid-Pacific when the KC-135 hovered 5,000 miles down range at about 40,000 feet to track an ICBM fired from Vandenberg Air Force Base in California. The missile was first sighted at an altitude between 200,000 and 300,000 feet.

... are "proving" that exercise is good for you.

The mechanisms by which exercise prolongs vigor and good health in aging humans is being studied by "exercising" protozoa, nature's smallest animals.

Dr. Alfred M. Elliott, University of Michigan professor of zoology, uses protozoa because the animals, only a sixteenth of a millimeter long, go through immaturity, maturity and aging in an average of

seven to eight days' time.

He has discovered that *T. pyriformis* do not show the usual symptoms of aging when they live in a tube that is shaken vigorously. Using automatic shakers, Elliott has maintained his protozoa in robust "youth" for days beyond what would normally be extreme old age.

The agitation is to protozoa, Elliott thinks, very much as exercise is to humans. He is now working to discover why the process retards or stops aging.

... say the prestige and influence of the family will continue to decline.

Dr. Robert S. Morison, director of Biological Sciences at Cornell University, expressed this view at a recent conference at Caltech.

The family, he said, is a relatively poor source for disseminating knowledge essential to survival in a rapidly moving world, and other agencies probably will be taking over the training of children at an earlier age.

The family, he also contended, will be downgraded by genetics as the basic unit of human reproduction. Among his points:

- Some geneticists suggest betterment of the species should follow the principles of animal husbandry, relying on artificial insemination for stronger progeny.

- There is a growing separation between sexual attraction and courtship, and the reproductive processes. The breaking of these moralities will produce big changes,

with difficult-to-predict social consequences.

- Growing knowledge of the plasticity of the human nervous system makes it clear that children can learn at much earlier ages than supposed a decade or two ago. It is idle to talk of a society of equal opportunity so long as that society abandons its newcomers solely to their families for their most impressionable years.

- The family should not be abolished, but some of its functions have already been taken over by social agencies and more are likely to follow.

... have been able to direct new bone growth in living animals by electricity.

Dr. Robert Becker, associate chief of staff of the Veterans Administration Hospital in Syracuse, N.Y., revealed the results of experiments with dogs. "By administering the correct amount of electrical current to areas of the leg bones," he said, "we have been able to cause the system to respond as though stress were being applied, and new growth appeared."

For many years, it has been known in human adults with mature bones that bone normally will grow to resist stress. In bones, the stress generates electrical current, the amount of which indicates the amount of stress, while the direction of current flow indicates the direction stress was applied.

The conversion of stress to electrical current is accomplished by

bone much as by semiconductors. Two elements of bone—collagen fibers and bone minerals in the form of crystals—are semiconductors. Their relationship produces a PN junction diode, which is capable of changing the mechanical stress in electricity. The electrical current directs the growth of new bone, keyed to the mechanical stress.

Dr. Becker's work duplicates the process. His purpose: to obviate the need for artificial "bones" and "joints," which wear out in a few years. Stimulated bone growth from the patient's own bone would not have this defect, and may be considerably easier to accomplish surgically than the implantation of metallic replacements."

... have a clue that hot peppers may keep you from having a heart attack.

Associate Professor Robert M. Grodner of Louisiana State University's food science and technology department, thinks there is a good possibility that certain circulatory diseases may be avoided by the consumption of capsaicin hot peppers, Tabasco variety. Capsaicin is the organic compound responsible for the "hotness."

Says Dr. Grodner: "There seems to be a correlation between the low rate of circulatory ailments among the Indians of the southwestern United States and their large diet of hot peppers."

Dr. Grodner says any guess at the manner in which the compounds in hot peppers may work in the sys-

tem to alleviate circulatory ailments would be "pure speculation at this point."

... are exploring the use of ultrasonics as a substitute for X rays in dental examinations.

Scientists and engineers at Battelle-Northwest, Richland, Wash., are undertaking the study for the Public Health Service to find a way of doing what X rays do without exposing a person to ionizing radiation.

Ultrasonic waves will be transmitted into the tooth by the use of a transducer. Once they have entered the tooth and surrounding bone and tissue, they will echo or bounce back. The echoes will be picked up on an oscilloscope, creating a picture of the various densities of the mouth's bone, tooth and tissue.

... think there may be a connection between cancer in cigarette smokers and rain.

It has been believed by some that such cancer may be initiated by radioactive lead-210 and polonium-210. Now University of Wisconsin soil scientists Chester W. Francis and Gordon Chesters say they have reduced radioactive contamination in tobacco by growing tobacco plants in rain-protected areas.

They discovered that the lead-210 and polonium-210 contamination of tobacco comes from natural radioactive fallout, which is washed out of the atmosphere and carried to earth by rain.

THE COLLEGE SCENE

How to find out

FIFTY institutions of higher learning have joined EDUCOM, the Interuniversity Communications Council. They represent about 40 percent of all university students in the United States.

That's the report of James G. Miller, principal scientist of EDUCOM and also director of the Mental Health Research Institute of the University of Michigan. Writing in *Science*, the journal of the American Association for the Advancement of Science, he says the council was formed "to provide collaboration among institutions of higher learning in their efforts to utilize the emerging communication sciences."

Today, Miller says, America is a "nation of information glut," but "many data-processing techniques have been developed during the last few years which are ripe for use in higher education. . . . Some offer great promise for increasing efficiency and decreasing costs. Each, however, needs to be evaluated carefully. Emphasis must remain on the human goals of educational institutions rather than on gadgets."

EDUCOM headquarters are at Fifth Avenue and Bigelow Boulevard, Pittsburgh, Pa., 15213. Dues are \$250. An independent unit may belong, but universities must apply for subsidiary units.



Sophomore biology assistant Janet Mattson helps in gnotobiological research at Montana State U. Gnotobiotics is the new science of all germ-free environments.

It happened . . .

- *Stevens Institute of Technology* reported that the industry interviewing schedule for seniors in February and March is already filled—indicating a continued large demand for engineers and scientists.
- *University of Southern California* began a pioneering curriculum of graduate study and research on Adult Development and Aging. Eight men are working toward an advanced degree in one of five academic disciplines — architecture, physical education, psychology, social work or sociology.
- *The Institute of International Education* reported that during the past academic year, nearly 92,000 foreign citizens were studying, teaching or doing research at U.S. colleges and universities.

People

- *Dr. Donald W. Taylor*, professor of psychology at Yale, appointed chairman of the department of psychology and director of the division of social sciences.
- *Nunzio Joseph Palladino*, pioneer nuclear power engineer, named dean of the College of Engineering of Penn State. He had been professor and head of the department of nuclear engineering. He succeeds Dr. Merritt A. Williamson, who resigned to become professor of engineering and management at Vanderbilt U.
- *Karl W. Deutsch*, leading political scientist, to join the faculty of Harvard July 1, 1967, as Professor of Government. A former M.I.T. professor, he has spent a decade at Yale.
- *Hans Bethe*, theoretical physicist who figured out what makes the stars shine, honored by other outstanding physicists in a day-long program at Cornell, where he has taught since 1935. His theory of energy production in stars explains the processes of stellar phenomena that are responsible for the birth and death of stellar systems.
- *Ivan E. Sutherland*, who pioneered a new way for men and computers to communicate easily with each other, has joined the Harvard faculty as Associate Professor of Electrical Engineering. He developed "Sketchpad," which enables an operator to convey information to a computer in the form of diagrams, geometrical shapes or graphs by using a "light pen" to write on a cathode ray picture tube.
- *Philipp Frank*, retired Harvard physicist and philosopher of science who died July 21, honored at a memorial meeting October 25 at Harvard's Memorial Church.
- *Dr. Joseph K. Hill*, in office as new president of Downstate Medical Center, Brooklyn, N.Y., and dean of its College of Medicine. *Dr. Chandler McC. Brooks* appointed dean of Center's new School of Graduate Studies in the basic medical sciences. *Dr. Marvin Stein* named new chairman of Department of Psychiatry.
- *A. Frank Tesi*, a Ph.D. in chemical engineering, promoted to full professor of clothing and textiles at Penn State, pointing up importance of chemistry in the curricula of students in those fields.
- *Prof. Leona Marshall* of U. of Colorado awarded a \$325,000 grant by AEC to continue study of elementary particles.
- *Ralph G. Pearson*, Northwestern U. chemist, given American Chemical Society's Midwest Award. He's author of so-called "Pearson's principle," which predicts whether compounds made of various combinations of "hard" and "soft" elements will be stable or unstable.
- *Dr. Charles B. Huggins*, professor of surgery at U. of Chicago and director of university's Ben May Laboratory for Cancer Research, awarded a Gairdner annual award (Canadian) for his work in hormone treatment of prostate cancer.

SCIENCE DIGEST SPECIAL

CITY PLANNING TODAY



158 precast concrete apartments have been built for "Expo 67" in Montreal. Upper-level covered sidewalks, drives are weatherproof.

THIS is a report on something that isn't. It could be. It may yet be. But today it's all still a dream—the dream's subject is City Planning—a nebulous area that is more words than substance, an unformed image, a half-baked thought if you like . . . and a thing without which, all too soon America will become a land of coast-to-coast insanity.

The time is 2000 A.D. Picture yourself downtown in an American city. People walk the streets with gas masks on their faces and oxygen tanks on their backs to fight smog. Each also carries his own flask of drinking water. The central city is a ghetto, choked by a sprawling collar of exclusive, segregated suburbs. The suburbs stretch for hundreds of miles. An all-day drive brings the family to one of the few remaining green areas left between this city's urban sprawl and the next one's. Miles of dwellings from the first half of the 20th century are

This Science Digest "Special," produced by Jeanne Reinert, is the first in a series of in-depth reports on broad scientific subjects of current interest. It is designed so that if you wish you can detach it from the main body of the magazine and file it separately. Next month's "Special": COMPUTERS TODAY.

Los Angeles

Cities will gobble up land
as they grow from their
1960 to their 2000 size.

1960	6,039,000
2000	12,754,000

disaster areas, fenced off from use. Traffic jams last for days.

Or will city planning bring another year 2000? Again, you're downtown in an American city. You walk down handsome malls lined with clean high-rise buildings and trees. Public carriers ride on air cushions above grassy paths.

Parks surround the city with ponds, lawns and outdoor beauty. Smog is unknown. Silent monorails glide swiftly in and out to whisk urbanites between home and work.

Social problems, from integration to garbage disposal, are non-existent. Cities and their services are supported by the National Treasury, not segmented municipal and suburban tax receipts primed with assorted state and federal funds.

Such are the choices for the city of 2000 A.D.

Chances are the shape of the city 33 years hence will fall somewhere between these two extremes. How much closer to one vision than the other will depend entirely on the type—and success—of plans made today. That's why city planning causes a furor—no one has a sure-fire success formula. Even new ideas are scarce.

Certain current trends can be extrapolated with confidence. Take the population. By the year 2000, 80 percent of the 330 million Americans will live in metropolitan areas compared with 135 million (70 percent) today.

Where will those urban centers be? Now, urbanites are crowded on one percent of the land. Why not put up cities in brand new places where scenery is unspoiled, where no built-in problems must be faced? No matter where it's put, the present supply of housing must be doubled.

Today's answer is the sprawling suburbs that offer thumbnail lawns and look-alike houses. Clearly, there is a limit to the scope of this type of expansion. The central city may still be a focus for jobs, but suburban folk take their paychecks and tax money home when they leave the city at night.

Little imagination, diversity or even oddball ideas can be found in the city planning market today. Yet, there are a few.

Underground buildings, for instance, are a possible ripple of the future. In a nationwide survey, the *Wall Street Journal*

Dallas	Chicago	New York	San Francisco
1,084,000	6,221,000	13,432,000	2,649,000
3,200,000	12,686,000	21,596,000	11,432,000

found advocates citing pluses: no noise, low exterior finishing costs, reduced demands on heating and cooling plants.

"We wouldn't trade our underground school for anything," said N. A. Howry, principal of an 18-room junior high at Lake Worth, Texas. Big jets roar overhead but can't be heard.

Most underground buildings are a box-within-a-box. The structure is put within a concrete shell after the hole is dug. Bracing between the building's outside and the shell's inside leaves an air space which, builders say, overcomes dampness.

Buckminster Fuller looks forward to a time when houses will be small, portable black shells containing all systems.

"Our present approach to housing is totally antiquated and totally wrong," he declares. "We will never be able to build enough decent homes for the millions of people in the slums in this country and around the world as long as we cling to real estate and heavy shells."

Fuller's answer is to outfit the space capsule as a complete, portable life system. "We are investing \$7 billion in it," he says. "It weighs 500 pounds. We can probably mass-produce it for \$2 a pound. That would allow the needs in a house—heat, cooling, water and waste regeneration—to amount to \$1,000."

He contends that we should concentrate on energy regeneration, not the house shell. Once these systems are compressed in a "little black box, then we and the box can be sheltered in a modern, totally equipped tent—lightweight, movable, mass-produced." There will be cities, but they won't sprawl. They'll be self-contained units piled up like beehives, each with a garden terrace. The static idea of roots in one city will be dead.

Today, too, we are seeing a start made on "new towns" (see page 58) which are planned from sewers to skyscrapers to civic centers before groundbreaking takes place.

There are many calls to action; few contain specific ideas. For instance, Dr. Simon Ramo, vice-chairman of TRW, Inc., a leading research firm, proclaimed at Caltech, "One of society's most urgent needs is to develop men who can effectively link scientific developments for social betterment." He pointed out that there are no such programs. He's right.

City Planner Dr. Constantinos Doxiadis, writes, "There is an imperative necessity to create new settlements within a new network of transportation that will function to serve the needs of the future." But he doesn't say how a city can zone, pay for and build an abstract suggestion.

Dr. Athelstan Spilhaus of the U. of Minnesota's Institute of Technology suggested a new city in a 1966 House hearing. It would have a system for reuse of sewage, noise abatement, industrial controls, and "could be used to try out new social methods and new legislation." But Dr. Spilhaus could not suggest a site, financing or how to attract a cross section of 250,000 Americans to live there.

Schools of architecture are just beginning to encompass a total view of a planned community. Traditionally, architects have been concerned with a single building at a time—a school, a home or an office building. Deliberately pasting together a total environment requires skills not yet familiar.

A systems approach has been urged by some. These, used in the nation's space ventures, might rebuild old cities and create new ones. A utopian city is envisioned, achieved by the joint efforts of engineers, economists, sociologists and the construction industry, financed by the Federal Government.

"There is a rising frustration matched by the growing willingness for experimentation," says Karl Harr Jr., president of the Aerospace Industries Association. "The necessary ingredients for these breakthroughs are all at hand—technological capabilities, identification of needs, the will to address these needs, the experience and public slant, private cooperation and the like. What is needed most is imagination."

Imagination—the bugaboo. Donald F. Hornig, director of the Office of Science and Technology, says that Federal funds find solid proposals too rare for investment in civilian problem areas. "We cannot buy and create progress in a field not ready to progress. We need to know where we are going and have enough people of the necessary competence to work out the programs," is his somber assessment.

Money, cautions John W. Gardner, Secretary of Health, Education and Welfare, is no panacea for urban problems. "I think we should be particularly wary of the old American habit of spending a lot of money to still our anxieties," says he.

Some ideas are practical, though they may only involve changing a custom. For instance, business hours could be staggered so all employees would not arrive and depart at the same

time. If widely adopted, this could end the jam-up on public transportation and highways. This sort of loosening would not make major changes in work or living habits, but it would change traffic congestion drastically.

Some street networks could be converted for bus use only. Metropolitan area transit could be scheduled by computer and the routes displayed electronically at each stop. Riders would know where a bus was headed, when the next one was coming.

Wilfred Owen of the Brookings Institution, has some new approaches to the transportation mess:

"1. The principal problem of cities is not how to move, but how to live. 2. Improving the conditions of living can do more than anything else to reduce the need for moving. 3. But providing transportation is not just a matter of getting things moved. It is also a major means of improving the urban environment. 4. Looked at in this way, transportation has ceased to be a problem, because technology and systems techniques have made it a solution."

Planned cities full of open spaces and matching facades offer no salvation, according to Leonard J. Fein of M.I.T. "Not efficiency, nor economy nor even neatness, the apparent ideal of most planners, is an intrinsically meritorious goal."

In *Technology Review*, he contends that the city's hallmark is diversity. In those drawings of malls, mile-high skyscrapers, monuments and new towns, you will never round a corner to a sudden surprise, the startling juxtaposition that connotes a city.

"The prevailing myth holds that if the automobile is banished from the central business district and all buildings are neat and clean, the quality of our life will change."

Disorder and diversity, he adds, does not have to be dirty. Rather, it can be a subtle chaos to reflect and encourage interpersonal disorder, which in turn staves off boredom.

Dr. Fein's frustration is with the idea that one formula will work. He complains that present formulae seek to de-urbanize the city. He opts for pluralism in the planning itself.

Burgeoning population may be an overworked phrase, but it does describe one that will double by the year 2000 A.D. No matter how you look at it, dwellings will be built somewhere.

City and regional plans must be shaped up. Lack of plans can only worsen existing mistakes, such as inadequate space for autos and trucks. Changes, per se, do not guarantee improvements. No area can vouch for a formula that works. But a choice between the two cities circa 2000 is at hand.

How to handle bigness

Most of us are painfully aware of the serious problems posed by our deteriorating big cities today.

Bigness in itself is not the problem. The problem lies in how we handle bigness.

Perhaps the most fundamental question of all is: How do we get from 1967 to the year 2000?

Here are 10 steps we must take:

1. Transportation

First we must be sure that our transportation system is an integrated network that includes all carriers—automobiles, buses, trucks, trains, airplanes. Unless we provide for rapid, safe and economical movement of people and goods, we will not have a viable city. And we cannot rebuild properly for the future.

It goes without saying that major traffic should be funneled through a few major thoroughfares, keeping as many streets as possible for local use. Parking should be restricted when necessary and confined to areas near arteries.

The future, of course, will see widespread use of moving sidewalks, pedestrian trams and small "urbmobiles" (see page 9).

2. Open Space

Steps should be taken *now* to save natural topographic areas such as woods, lakes, stream valleys and rugged hilltops from private exploitation. The United States is sadly lacking in parks and greenbelt areas when compared to Europe.

Once this open space is acquired, recreational facilities for people of all ages should be built. Between now and the turn of the century, leisure time and per capita income will rise significantly and we should provide facilities in our cities where both can be spent.

3. Planning

The planless, aimless city of the past is a luxury that an increasingly urbanized United States cannot afford. Land use should be carefully planned to avoid the sprawling, homogenized appearance that many of our great cities have already taken on.

Land use should be highly concentrated and tied directly to the principal lines of transportation. This is to say that there should be clearly-defined regional shopping centers, industrial concentrations, high-density shopping clusters, etc.

Once this takes place, a wide variety of choice (geographically and structurally) is available to the industrialist locating his plant, the merchant finding a store location, the home owner choosing a house.

by Calvin Hamilton
Director of Planning, City of
Los Angeles, as told to
Andrew Hamilton



4. Neighborhoods

We need to organize neighborhoods in natural clusters so as to provide adequate shopping areas, employment opportunities, schools, churches, cultural and social facilities. The elementary school is ideally located at the center of the neighborhood so that small children will not have to cross major thoroughfares to reach it. The neighborhood park should be located next to the school and linked to residential areas by a system of park-walkways.

In the future, the use of electronic devices will help accelerate decentralization of governmental offices and services.

5. Public Services

Public services such as water, gas, electricity and telephone should be ready and available to new developments. Sewer construction, water mains, highway and road development should precede—and in some cases encourage—private development of land. The school system should keep ahead of growing families.

6. Industrial and Commercial Development

The city of the future must provide industrial areas so located that it is economically feasible to obtain raw materials, manufacture products and provide employment. These areas must be convenient, attractive and safe.

Similarly, the city must allow for commercial areas of sufficient size and proper location so that the public may be adequately served. Commercial areas that are inconvenient, uneconomical or unattractive should be redeveloped or renewed.

7. Cultural Development

The city must provide its citizens with a wide variety of cultural facilities that allow them to enrich their emotional lives and to explore new intellectual pursuits. This will necessitate a balanced program of museums, auditoriums, libraries, zoological gardens, garden centers, nature trails, etc.

A few of today's cities are pointing the way toward greater cultural facilities: New York with the Lincoln Center for the Performing Arts, Los Angeles with a new art museum, music center and zoo; Washington, D.C. with a new cultural center. Many similar projects are on the drawing boards.

What the government is doing

To cope with present city woes, the mayor of Detroit estimates his city needs \$15 billion, the mayor of New York estimates \$50 billion. The National Planning Assn. says all cities will need \$2.1 trillion spread over the next 20 years.

A small pilot program, Demonstration Cities, was approved in '66. It is the first to demand broad plans. Since 1949, grants for urban renewal have been available to tear down rotting buildings, erect new ones. Scant attention was paid to the total effect of changes.

Congress must pass an appropriation bill each year to fund all or part of an authorized program.

For fiscal year 1967: \$12 million was authorized, \$11 million has already been appropriated; \$11 million will be split among cities to plan "demonstration" areas.

For fiscal year 1968: \$12 million was authorized for planning and \$400,000 to carry out approved plans.

For fiscal year 1969: \$12 million was authorized for planning, \$500,000 for action on plans.

The new Congress will decide how much money will be spent of the sums allocated.

8. Community Attractiveness

It is sometimes said that in the 20th century we have sacrificed the city beautiful to the city functional. I think we will see a reverse of this by the year 2000. A city should be—and will be—as clean and beautiful as man can make it. Federal and municipal governments should set an example in the design and quality of public buildings, and in their landscaping and maintenance.

9. Technological Change

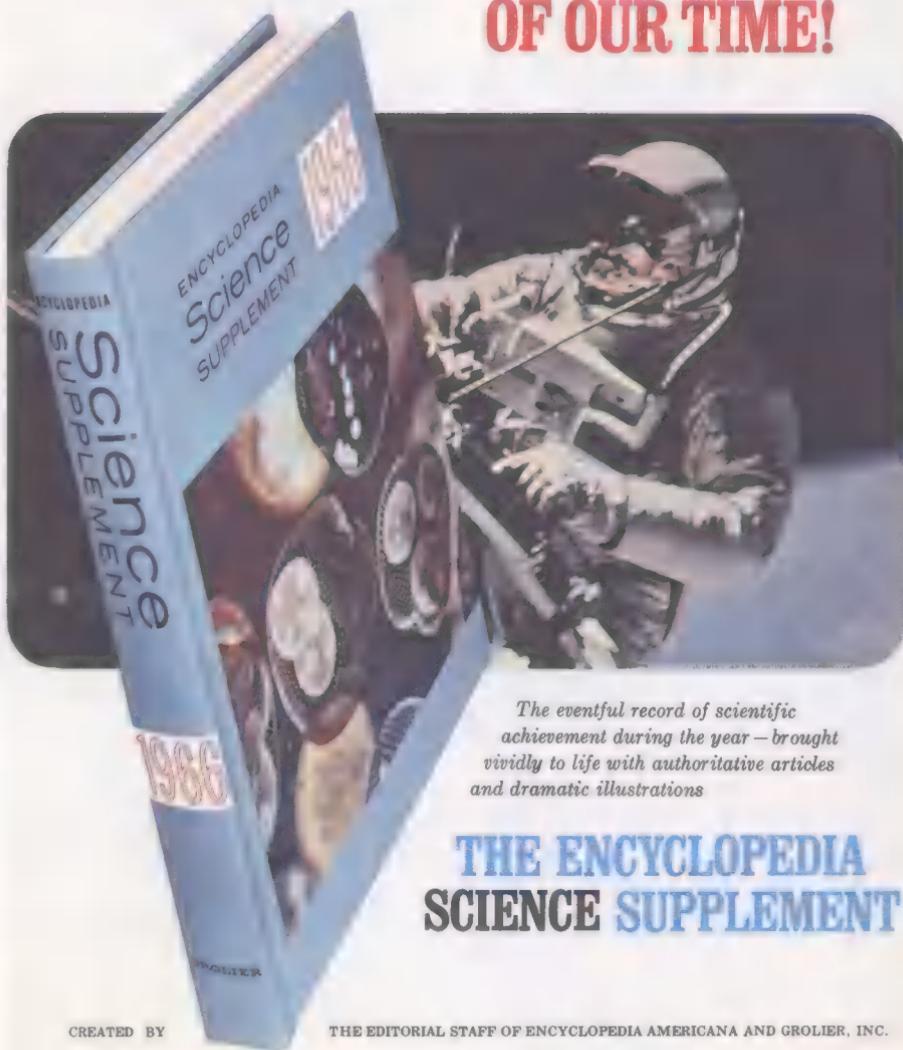
New materials, new methods of construction, new building ideas are pouring out of laboratories at a furious pace. But engineers and scientists complain that they have not been given an opportunity to show what they can do to improve our cities. Building codes should be revised to unshackle the creativity of architects, engineers and builders. If technological developments of the future render policies and plans obsolete, they should be scrapped without hesitation.

10. Renewal

And finally, a city must be committed to continuous renewal and rebuilding of worn-out areas to bring them in line with changing human needs and desires. The spread of urban blight can be checked by applying constant and vigorous preventive measures.

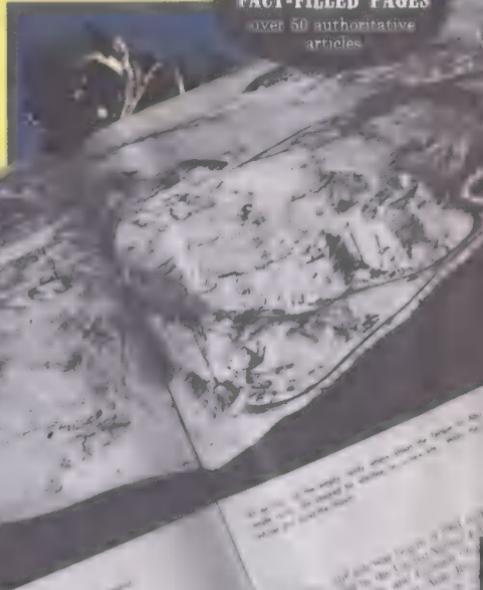
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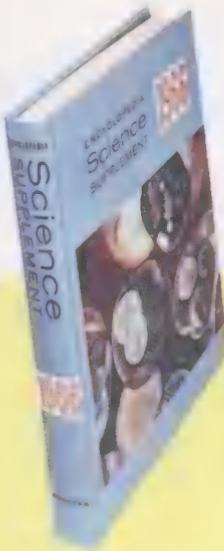
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U.P.I.

How crowded should we be?

AREN'T there just too many people in cities in too little space? When today's cities are replanned and tomorrow's designed, how much elbow room should we leave?

Until recently, the only criteria for overcrowding people were extreme incidents that led either to insanity or death. Today, however, evidence is growing of much more subtle measurements in two fields, "territoriality" and "proxemics." The first is a compulsion to possess and defend an area as an exclusive domain. Proxemics is a new discipline to study social and personal space and man's perception of it.

First clues of the broad base to territoriality came from studies of animals and birds. Four discrete distances have been determined for each species. *Flight distance*, so precise it can be measured in inches, is that at which a danger causes flight. *Critical distance* is the narrow zone separating flight and attack distances. *Personal distance* is an invisible bubble of space that separates each member of a non-contact species from his fellows. The fourth space is a bond, *social distance*, and it keeps members of a group in contact with one another. It may vary from within earshot to the reach of a mother's arm while crossing a busy street. The telephone, TV and two-way radio have greatly expanded man's social distances.

A population ferment and crash may arise when there is not sufficient room for each animal's own territory. For instance, the crab *Hyas Araneus* will turn to cannibalism when too densely packed. Lemmings, rats and rabbits have been observed

committing mass suicide after population buildups. Rats neglect their young, violate courting customs and become homosexual when jammed together (see "Disaster from Overcrowding," July, '65).

Sika deer on James Island gave John Christian a chance to study histological changes during a population buildup and die-off. Careful studies took place in 1955, during the buildup. Deer began to die *en masse* in 1958-1960 despite an adequate food supply. Nine-tenths of the 190 fatalities were does and fawns. Both the 90 to 110 survivors and the casualties were good-looking, supple and plump. However, during the maximum density and die-off period, the deer's adrenal glands swelled in size, finally decreasing to 46 percent of what they had been. Now, adrenals regulate much of the growth, reproduction and level of body defenses. Because their size and weight respond to stress, adrenals are not a fixed size. Overactive and enlarged adrenal glands signify overstress. "Mortality evidently resulted from shock following severe metabolic disturbance," Christian reported, "probably as a result of prolonged adrenocortical hyperactivity, judging from the histological material. There was no evidence of infection, starvation or other obvious cause to explain the mass mortality." Curiously, deer were 30 percent larger in body size after the population stabilized.

*Studies
show
crowding
can
bring
subtle
body
changes.*

Endocrine studies have produced unsuspected subtle connections between the body and environment. A. S. Parkes and H. M. Bruce discovered that, during the first four days after conception, the presence or smell of a male mouse other than the mate would suppress a female mouse's pregnancy. Such a delicate chemical link between the body and environment may indicate further physiological ties between an individual and abnormal behavior that comes with excessive crowding. There is no reason to exclude man from these regulating mechanisms. It's hard to pin down historical precedents. However, severe overcrowding went hand-in-hand with industrialization in the mid-14th century. Two-thirds of the population was wiped out by the Black Death, or plague. It's quite possible, says Edmund Hall in *The Hidden Dimension*, that overstress led to lowered resistance. Interestingly, he points out that architectural changes that protected and solidified the family coincided with the end of the plague. Functions were assigned to various rooms instead of making a Grand Central Station of each.

Probably the only study of human pathology and insufficient

*If an
Arab
wants
to be
alone,
he
quits
talking.*

space is by a French couple, the Chombard de Lauwes. In housing for French workers, they found social and physical pathologies doubled when less than eight to ten square meters per person was present. Pathology also climbed, but not sharply, when available space rose above 14 square meters per person.

Because cultures build in territorial behavior, adequate space for one culture may be completely wrong for another culture. Enter proxemics. Hall contrasts the Arab and American cultures and finds space is perceived quite differently by the two. An Arab is intensely involved with other people through his senses. Breathing on someone else during conversation is the preferred way to communicate. To withhold one's breath is to act ashamed. In public places such as buses and bazaars, Arabs will jostle and shove one another because an individual in public has no right to be untouched as he does in the U.S. or Europe. An Arab home is a protective shell for the whole family. By U.S. standards, it has inordinately large rooms, high ceilings and long vistas. There is no physical privacy as we know it in the Arab family, nor even words to connote privacy. If an Arab wants to be alone, he quits talking.

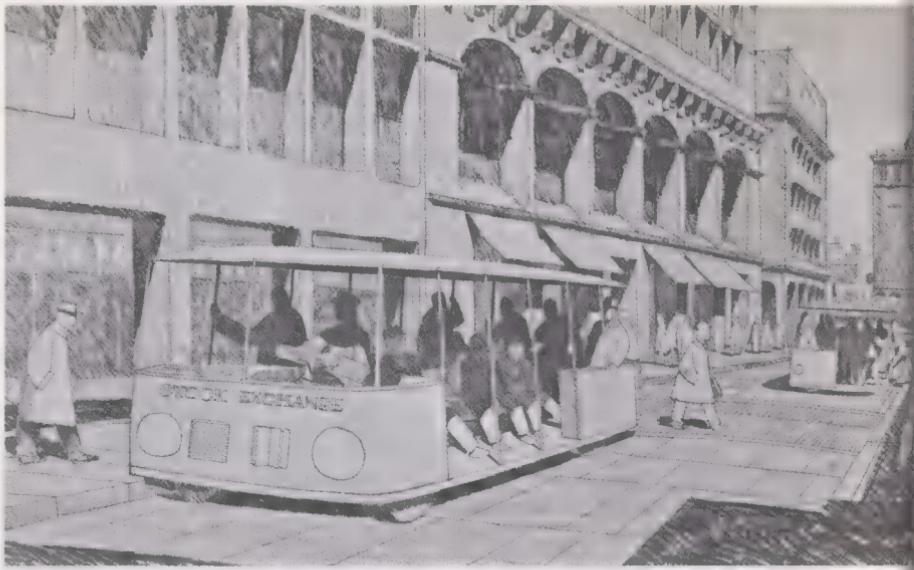
"Puerto Ricans and Negroes have a much higher involvement ratio than New Englanders and Americans of German or Scandinavian stock," observes Hall. "Highly-involved people apparently require higher densities than less involved people and they may also require more protection or screening from outsiders." Hall thinks intensive studies in proxemics could reveal the best densities for various ethnic groups.

To city planners, he suggests:

1. They should find methods to compute and measure the cultural dimensions of optimum human scales and ways to fit the automobile into a tolerable human scale.
2. Methods should be found to reinforce ethnic bonds so spaces will be compatible with needs of diverse cultures.
3. Large, readily available outdoor spaces should be conserved. If they are destroyed, it could be serious, even fatal, to future generations.
4. Useful, satisfying old buildings and neighborhoods should not be wiped out by urban renewal projects.

Animal studies seem to say that crowding per se is neither good nor bad. But they also make clear that overstimulation and disrupted social ties, due to overlapping personal distances, lead to population collapse. This is plainly a field for research and application before cities reach their 2000 A.D. dimensions.

Old cities rebuilding



To revamp existing cities, first step is a comprehensive transportation plan to separate pedestrians from local and through traffic. A bold proposal for lower Manhattan calls for noiseless, open-sided intra-buses to share and serve pedestrian malls. The shop-lined malls are now narrow, winding 17th and 18th century city streets lined with 20th century skyscrapers.



Manhattan's plan for the year 2000 includes a waterfront esplanade. It would connect six waterfront plazas, each a focal point for 10-15,000 residents. Land would come from redevelopment plus 200 acres of fill to replace obsolete piers.



A ship-shaped office building looms as part of Constitution Plaza in Hartford, Conn. The pedestrian plaza with hotels, shops, underground parking built in once rundown downtown area spurred investment.

U.P.I.



U.P.I.

Face-lifting tactics instead of wholesale demolition restored a 20-block area of colonial Philadelphia. Historical charm was retained.

Alcoa is building the 180-acre Century City in Los Angeles. The 800-room Century Plaza Hotel opened last summer. Four million sq. feet of office space, 5,000 apartments are being built.



New cities abuilding



Building of new cities begins after plans are completed. Marco Island, off Florida's coast, centers around salt water sports, second homes.

Permanent open space is being built in nine villages surrounding a central business area in Columbia, Md., designed for 110,000 people.

Wide World





Reston, Va., to be a self-sufficient community for 75,000 residents, is the vanguard "new city." Another new idea is the Rossmoor "Leisure Worlds" for retired people.



Pedestrian plazas will provide each Reston village with a shopping and community center. J-shaped mall above includes an art gallery, teen-age lounge, auditorium and nursery. Every resident can walk to the plaza on paths through the woods.

Lakefront townhouses (left) are but one type of Reston housing. Others are high-rise and garden apartments and detached homes. Recreation areas include tennis courts, riding stable, playgrounds, swimming pools, and 72 holes of golf courses.

Science Digest suggests - an editorial

WE consider that the problem of America's cities is the second most vital matter today after national defense. If defense were handled as shabbily as are our urban affairs, our country would be facing disaster.

Yet, if an enemy never lifted another hand against us, we could still encounter disaster. The wild proliferation of our cities gorged by population increases, and the rush from the farms continues unchecked, unplanned, unstudied.

Fly over this land and you see the mad, undiscerning, formless sprawl of urban ugliness spreading ever farther and farther across the landscape. Is it to be our mark as a nation that we built an uninterrupted system of grubby, faceless streets and city blocks from coast to coast and border to border? Drive through any city today and you can see it happening.

You look for someone to blame. You pray for someone to point at. It would then be so simple to fix it all. But, of course, it is at ourselves that each one of us must point.

- Government must act, by fiscal changes, to meet this urban age, unhobbled by political boundaries and a morass of tax systems that belong to the horse and wagon era.

- Business must act, by responsible policies in pollution control, by cooperative planning that blends its needs with those of the public weal, like transport, housing, education and, yes, esthetics. Many of today's big companies already act that way. What about the thousands without names to protect?

- Science must act, by recognizing the field as one comprehensive area demanding systematic study and action, not fragmented tilting with the lances of tidy little disciplines.

With science to point the way to the answers, business to implement them and government to ratify them, a big start could be made now—not tomorrow when the solutions will be twice as difficult, but today, before the problem engulfs us.

We propose a National Commission composed principally of these three most involved segments of our national life. We propose it be broad but not big, thoughtful but not ponderous, speedy but not hasty. And we propose that interested parties meet now to form it and keep it going until the day returns when we can sing, and mean it, America, the Beautiful!



Last weekend I learned to fly

by Jane Bryant

THE propeller was going pocketa-pocketa-pocketa as I lowered my goggles and taxied briskly into position. My instructor, in the adjoining seat, sweated in silence. With throttle in, I barreled down the uneven runway, pulled back on the stick and lifted our red-and-white Cessna 150 into the air.

Suddenly, I was Amelia Earhart, banking the plane into a series of dazzling turns, until my worried companion spotted the airport. I made a fast approach, dropped down over the fence, chopped the throttle and greased the craft faultlessly onto the deck.

"Good job," said the instructor. "Well done."

So passed my third hour of flight instruction in an unusual course called the Pinch Hitter. My instructor's primary job was to give me confidence in my ability to fly. To this end, he employed the fiction that I was Amelia Earhart—and I happily bought this fiction without even caring that his own hands kept sneaking to the controls to help me out.

Is this any way to teach a girl to fly? You bet it is, says the Aircraft Owners and Pilots Assn., developers of the Pinch Hitter course. What's more, it can persuade a woman who has always hated and feared flying that airplanes can be fun.

This is a formidable task, but one the AOPA felt must be tackled.

Nearly half a million families now make as much use of the airways as they do of the thruways for vacations and weekend outings. On most of these trips, the husband does the flying, the kids read comic books in the back seat and a frightened wife and mother sits stiffly up front, expecting every moment that her husband will make a mistake, the engine will quit and the plane will fall from the sky.

The safety statistics for general aviation give the lie to the women's fears. It may be true that hubby can't clean the leaves out of the gutters without falling off the ladder, but his chances of pasting his plane against a mountain or spinning downward to certain death are extremely low; there are only .2 fatal accidents for every million plane miles flown. The likelihood that he will suffer a fatal in-flight illness, leaving his wife in charge of the plane, is even more remote—about once in every 10 million miles flown.

But, as those involved with general aviation know, the fear of flying is too irrational a fear to be beaten back with a column of facts and figures. So the AOPA decided to try a new tack.

In the summer of 1963, the group began to plan a course in flying for non-pilots who intended to remain non-pilots, but who nevertheless could expect to spend a good deal of time in the air. The AOPA had the wives of private pilots in mind, and they thought of their course as having three practical benefits:

First (and this was the argument they used to lure the women into the course), anyone who flies a lot should be prepared to take over the controls just in case anything does happen to the pilot in mid-air. A woman and her family would probably feel a lot safer aloft if she were capable of handling the wheel from the right seat, finding help on the radio, navigating to the nearest airport and setting the plane down, if not smoothly at least safely.

Fear disappears

Second, speculated the AOPA, if a woman understands enough about a plane to fly it, the chances are that she'll lose much of her in-flight fear. She'll also lose the feeling that her life is dependent on the whim of weather or the lightning judgment of her pilot (who is only her husband and who she knows for a fact has *not* got lightning judgment). Says Ralph Nelson, the AOPA's project director: "We make the unknown known, so that the fear of the unknown can no longer exist."

Third (and this function of the Pinch Hitter is never stated explicitly), the course often acts as a subtle marriage-counseling program. In many families, plane ownership has resulted in serious division between husband and wife. Women who fear flying can grow bitter and resentful at the time and money their husbands lavish on the hobby. In cases like these, the Pinch Hitter represents an effort by the AOPA to convince the women

Praise—and practice—dispels wives' fear of flying.

to join what they evidently can't lick in order to restore some serenity to their homes.

Now comes the hard part. How do you teach this group of nervous Nellies and outraged Lysistratas (most of whom are there against their will) how to find happiness aloft?

Flying clinics

To find out, I signed up for one of the AOPA's flying clinics, this one meeting at Patrick Henry Airport in Newport News, Va. The clinic is a three-day educational project designed to improve the skills of private pilots. It offers six courses in navigation and instrument flying plus the Pinch Hitter, and on the weekend that I offered myself up as guinea pig, 21 other women (plus two teenagers and two men) trickled into the ill-lighted hall for our first night of ground school. We laid our notebooks on green-covered banquet tables and nervously looked each other over. We seemed ordinary enough. No obvious superwomen in sight. No sleek, competent types. Just a clutch of worried women, wondering how we ever got ourselves roped into this insane adventure—and all of us sure we were going to fail.

Don Sundin, manager of the Newark, Ohio, Municipal Airport, opened ground school on a bright

note: he threw out a husband who wanted to sit in and see what the ladies were up to. "Husbands are lousy instructors for their wives," he explained. "They have no patience." We all nodded agreement and smiled superior smiles as the gentleman slunk out of the room.

Clearly, Don Sundin was a sympathetic type. He lectured us on how stable planes are ("They'll practically fly themselves"), promised us a smooth ride ("No sharp turns, no stalls"), told us we'd all do beautifully ("The airline industry has been astonished at our success with pinch hitters") and entered an institutional ad ("Aviators are wonderful people").

He fielded all our frightened questions and took them seriously. "If the engine quits," he said, "you could fly with no engine for at least another five minutes, and would have a range of about 150 square miles to find a place to set down in."

Then he talked about a plane's controls, and wound up the evening with a film about a couple that faced a marital crisis over the husband's plane. Many of our number nodded and murmured yes, that was just how it was. Of course, through the Pinch Hitter, the film couple found happiness again. We all went to bed nervous.

I drew the choicest hour for my first flight. I was due to take off at

6 a.m. "That's when the air is smoothest," said Basil Maile, a gentle, competent pilot and an employee of New York's Flight Safety Foundation. In the damp and chilly dawn, he sorted out the instruments for me ("This is the oil pressure gauge, but you won't have to worry about that") and soon, with our four hands on the dual controls, we took off.

And suddenly there I was, executing easy turns, gentle climbs, cautious descents, with Basil at my side telling me I was marvelous. The next time we took off, the only hands on the wheel were mine. "Wonderful," said Basil. "Splendid. You have a natural ability for flying." We landed four-handed, and I received a brief pat on the back. "Excellent," it said on my report card. "An apt student."

It's a little embarrassing to discover how quickly women respond to flattery. That night at ground school, we were a changed group. Questions dealt not with engines that quit, but with rudder controls and the proper use of carburetor heat. Don Sundin taught us about headings, omni radio and how to bracket a course; we talked about landing procedures without turning a hair. We even looked different. The night before, we had straggled in, tired, irritated and under protest. But the second night, we were crisp and fresh, every one of us pretty. We talked fake pilot talk and practiced "hanger flying."

The next morning, we were up again at 4:30 and into the air at 6.

By the time we had completed our fourth and last hour of instruction, we had all landed our planes several times—bumpily and usually subtly assisted, but we had brought them down.

So what is the secret of the AOPA Pinch Hitter? It is, of course, the shrewd use of psychology—dealt out as a kind of flattery therapy that was easy to spot but impossible to resist.

The AOPA's Ralph Nelson says that more than 4,000 women have taken—and "successfully" passed—the Pinch Hitter since its inception.

Here's the official explanation of the Pinch Hitter, given to me by Jack Eggspuhler, associate professor and chairman of the aviation department at Ohio State U.

"Most of these women have been flying with their husbands for years and already know a good deal about their planes. What we do is to give them the courage to use the information they already have. The instructors are here to show them the road to success. We de-emphasize the technical aspects of flying and—most importantly—keep any husbands who might laugh or sneer at the ladies out of the way. And we give them plenty of scope for group therapy—that is, encouraging the women to get together, compare notes, discuss their problems and generally help each other along. There's a real emotional intensity about the women in this course. These gals have to triumph and we make sure they do."



Tomorrow's new foods

Strange but more convenient, nutritious and plentiful eats are promised by research.

John Smith, director of the Agricultural Research Center, reports in a Science Digest interview.

by Victor Block

In looking ahead 30 years or more to learn what will be in store for our stomachs, what are the areas where we might expect the greatest changes?

Well, we ordinarily think about food in terms of three major groupings. These are animal products—including meat, eggs and poultry, and milk and other dairy products; cereal products; and fruits and vegetables. In the animal products the big trend is not toward individual products, but rather to having them combined into dishes. The housewife of the future will not go to the store to buy a single commodity—she'll select from among a

number of prepared dishes. If she buys roast beef, she'll pick out a cut of whatever size or number of portions she wants. This is called portion control, and it's coming into widespread use very rapidly.

For example, food on most airlines is pre-prepared and portion-arranged, and much of it is quite good. Some of the large hotel chains use completely pre-cooked foods, and most people don't know the difference. So do a number of restaurants, including some of the higher-priced ones.

This trend will continue, and will move into the supermarket and the home. Frozen dinners, which are markedly improved over just a few years ago, will become much more

popular and widely used. Frozen gourmet foods will come down in cost, as they gain acceptance and as competition to make and sell them increases. Frozen boil-in-the-bag foods will be in widespread use. Freeze-dried products, made by removing the water under vacuum while still in a frozen state, will gain in popularity. Freeze-dried fruit pieces are already being put into cereals, and we're testing other varieties, such as freeze-dried omelets, instant coffee, ice cream and even some gourmet items.

Will there be other noticeable differences in the meat products we buy 30 years from now?

Oh, yes. For example, the new thing today is the injection of tenderizing enzymes into animals just before they are slaughtered. This gives much more tender meat—even for the less expensive cuts.

Genetics, too, will be playing a large part in the meat we buy in the future. We're already well along in the development of more rapidly growing types of animals. Thirty years ago, it took 15 weeks to raise a chicken to maturity, even with the best of feed and care. Today, we have reduced this to 10, and even as low as 8, weeks. In this short time we now have broilers with breasts twice as large as they once were.

Through genetics, we can also put an animal into just about any shape we wish. An example of this is the broad-breasted Beltsville

turkey, which was developed several years ago. Of course, we can't promise to come up with a three-legged chicken, so mom and dad and junior can each have a drumstick. But the good points of each animal—the meaty areas, the best portions—will be emphasized through selection and breeding.

Will the trend toward more frozen and prepared products hold true for the cereals as well as for animal products?

Definitely. Even today, the home sale of flour doesn't amount to much at all. In the years ahead, more and more housewives will learn how good frozen baked goods are, and will switch over to them. At the same time, they will discover that the large food processing plants can produce top-quality baked goods at lower cost than that the woman bakes at home.

It's already astounding how little time a housewife has to spend in the kitchen to feed her family. In the future, cooking—baking bread and cakes, preparing meals from scratch—will become little more than an outlet, a hobby, rather than a necessity.

Are any new types of cereal products in the works?

Yes, all the time. One, developed by the U.S. Department of Agriculture laboratory in California, is called wurld wheat, from Western Utilization Research Laboratory. This is a lye-peeled wheat that somewhat resembles rice in appear-

ance, but has a flavor and texture all its own. It has excellent quality and flavor, and may be used in a variety of ways. It's good as a dessert base with a variety of sweeteners, and is excellent with meat stock as a main meal side dish.

Another new product is dehydrated peanuts, which are then pressed to remove up to 80 per cent of the oil. When the peanuts are placed in water, they swell back to their original size and shape—but have only about 20-to-40 percent as much fat as before.

What will the housewife find in the fruit and vegetable bins?

In the next few decades, two opposite trends that are underway will both continue. One is the use of frozen produce. The use of frozen fruits, especially, has not increased as quickly as most of us expected. Now, we have a major breakthrough that is expected to change that picture. This is freezing in liquid nitrogen at extremely low temperatures. With this method, it's possible to quick-freeze even such perishables as fresh strawberries, tomato slices and other delicate fruits and vegetables, with excellent results. So we may expect a big increase in acceptance and purchase of frozen produce.

On the other hand, a counter-trend has been set in motion, largely by modern transportation methods. This is the possibility of getting really fresh-picked produce into the market. This development has been coupled with breeding of

varieties that stay fresh much longer.

Many may recall stories told by their parents, perhaps with a sly grin, about picking corn on the farm and jumping on a horse to get the corn into a pot before it lost its sweetness. Today we have hybrid varieties that maintain their sweetness for as long as a week, so there's no need to have a horse standing by and a pot of water already boiling.

Combined, the better transportation and genetic improvements have greatly increased our ability to fulfill people's desire for fresh fruits and vegetables. Today, large quantities of strawberries are flown from San Francisco to Western Europe at a cost of only about seven cents per box for transportation. This means that the Europeans can have almost field fresh strawberries whenever they want them. In this country, I expect to see a similar increase in the demand for tropical, exotic fruits that will bring them out of the specialty stores and into the supermarket.

Will there be an increase in the availability of dietetic and geriatric foods?

Quite definitely. This is a very important trend too, and in the years ahead will claim a growing percentage of the food dollar. Already, we have a rather complete line of low-calorie foods. Excess calories, of course, are the major nutritional problem we face in this country, so the low calorie items will be in increasing demand. As we become less and less active in the

De-fatted foods will be in greater demand as we become less active.

future, and require even fewer calories, more people will turn to these de-fatted foods.

Let's look at just one example of our efforts in this direction. We're working on cheese, trying to make a whole, hard, cheddar-like product with a greatly reduced fat content. We have an experimental product that looks and tastes very good, and has only about as much butter fat as cottage cheese.

As for geriatric foods, the major problem here, I think, has been the name. People just don't like to go into a store and ask for old folk's food. But those who require special diets will find a wider variety on the shelf. Things like the so-called meat analogue products—vegetable-based frankfurters, hamburgers and so on—will become less expensive and more widely accepted.

What we do here is take vegetable protein isolates, such as from soybeans, put them into fiber form and spin this into products that actually resemble the texture of ham, chicken, turkey and other meats. With new advances in flavor research and the artful use of food coloring materials, we can come up with an authentic-looking fatless meat substitute.

Will the over-all price of food be relatively higher or lower in the year 2000 than today?

It looks as though food prices

will drop in the years to come. There has been a steady decline in the price of food in relation to personal income. In 1950, food accounted for about 22 percent of disposable income. Today, we're down to 18 percent—a much lower figure than any other country. This trend will continue as the cost of production—on the farm, in the processing and packaging plant, of transportation—is brought down.

Here at the Agriculture Department, we're taking a hand in this search for less expensive methods of preparing food. One major problem today is in the dairy industry. It's getting more and more expensive to run a successful dairy farm, and the cost of milk, as we all know, has been rising. To meet this problem, we've come up with a dry whole milk that can be readily dissolved. The powder maintains its flavor for about four months, which is long enough for institutional use but not for market and home shelves. When we lick this factor, the housewife who will use the powder will get a product that she cannot tell from whole, fresh milk at a saving of about seven cents a quart.

It sounds as though you are actually improving on nature in a number of ways.

In certain respects, that's correct. I already mentioned advances in flavor research. One example of this

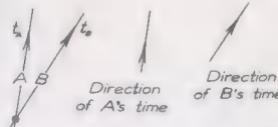
is the use of what we call flavor potentiators, which really do help nature along. With the chemical knowledge at our disposal today, we can isolate and identify the complex chemicals that are the flavor components of food.

We're also trying to give nature a boost in our efforts to find truly synthetic food sources. A man associated with a major meat packer is working on the fungus mycelium, grown on the byproduct of animal slaughter, as a protein source. A number of companies, both here and abroad, are looking into the use of petroleum as a source of edible protein. These are possibilities for the future. And of course, some people are talking about algae as the food of tomorrow.

Then, too, our space activities have led to a lot of food science research. What we're really after here is some means of processing human waste so as to return it into food channels. Once we achieve that, space travelers will have a closed nutritional system on long journeys.

Is it possible that the visitor to the supermarket of 2000 A.D. might not even know he's in a food store?

No, I don't believe that will be so. We'll still see heads of lettuce, and fresh fruit in even greater variety than today. And the many new products will be so attractive, convenient and tasty that I doubt many housewives will long for the good old days of 1967.



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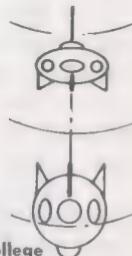
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A black and white micrograph showing several dark, irregularly shaped microorganisms, likely bacteria, against a lighter, textured background. Some of the organisms appear to have thin, wavy appendages.

Wriggly black spots are bacteria revived from pre-Cambrian era by Dr. Dombrowski.

These
creatures
are
**5 hundred
million
years old**

by Nino Lo Bello

VISITORS and patients who go to bathe in the thermal pits of Bad Nauheim, a spa in Central Germany, are not aware that the healing waters around them gave rise to one of the most remarkable experiments in recent years.

A West German researcher, geobacteriologist Heinz J. Dombrowski, spotted some hitherto unknown organisms in the Bad Nauheim waters which flow for 45 miles through primeval salt beds before bubbling to the surface from 3,000 feet below. Dr. Dombrowski's curiosity led him to the nearby salt

mines and opened the door to a number of experiments which have brought back to life creatures that may be millions of years old.

The tiny organisms that Dr. Dombrowski extracted from the ancient epochs of terrestrial history, were in a "state of sleep" (anabiosis). It took over 100 tests before Dombrowski could be sure that the primitive beings he had "reanimated" were actually from the Paleozoic era. He had to be 100 percent certain that no outside organisms of later date had crept in to confuse the issue.

Once having ascertained that no contamination had taken place, and

having proved that the unicellular creatures were several hundred million years old, he isolated them and made them resume the life which had been interrupted eons ago—as though time had stood still.

The Dombrowski discovery represents a major break-through in the study of the longevity of organisms in a dormant state. Up to now the most well known record of survival is the seed of the lotus *Nelumbo nucifera* which lay in a peat bog for more than a thousand years. In another instance, two American scientists, G. S. Wilson and H. L. Shipp, found viable spores of a thermophilic bacillus in a tin of meat which had been canned 118 years previously, while two other French scientists reported that anthrax spores prepared by Louis Pasteur in 1888 were alive 68 years later. University of Vermont scientists found living bacteria inside clay bricks of an Egyptian temple 34 centuries old.

"When we consider the survival of organisms over very long periods," explains the 46-year-old Dombrowski, who became a medical doctor in 1948 and won his Ph.D. for biological sciences in 1951, "we have to take into account the spontaneous chemical breakdown in those organic molecules which form the essential organizational structure of the cell, in particular, proteins and nucleic acids. Microorganisms can survive for millions of years under certain conditions in which essential and labile metabolites are preserved, and the structur-

al breakdown of proteins and nucleic acids would also be exceedingly slow."

At Bad Nauheim, the German scientist worked with rock-salt deposits of the Permian era, estimated by geologists to be between 180 and 200 million years old. He successfully isolated seven different species of living bacteria from the Permian limestone, the most recently formed stratum of crust. This enables science for the first time to carry out a direct experimental investigation of vital processes from the earth's oldest days. Before, paleontological research has had to be based exclusively on the study of form and structure of plants and animals.

After his first investigations with the Permian rock salt, Dombrowski, a member of the New York Academy of Sciences, extended the scope to even more ancient salt deposits. One such experiment took him to Pugwash, Nova Scotia, where with three other scientists (C. G. I. Friedlaender and Douglas H. Loring of Canada, and Robert Kuehn of Germany) he found evidence for the presence of dormant bacteria in salt of the late Mississippian period (over 300 million years ago).

"Other investigators," declares Dombrowski, "were also successful and permitted me to find traces of still living germs contained in Carboniferous rock salt (260 million years old), in middle Devonian salt (approximately 360 million years old), in the 400- to 500-million-

year-old Silurian salt and also in earth's oldest salt deposit, the 500- to 600-million-year-old early Cambrian formations.

Since Dombrowski's research was subject to a multiplicity of errors, the methodology of his experiments became a foremost concern. The salt rock under investigation had to satisfy all the criteria of primary genesis—that it originated from a tectonically untroubled site within a larger rock salt deposit and that its formation had suffered neither transcrystallization nor recrystallization. Everything contained in this salt, including some bacteria which inhabited ancient oceans, had to be as old as the salt itself.

Sterile salt-blocks

In bringing blocks of salt to his laboratory, Dombrowski had to be careful to avoid unwanted infiltrations by recent bacteria. So he took the following precautions: He set up a tiny lab in which an ultra-violet sterilization lamp had burned for 120 hours. The experiment table and tripod were covered with sterile cloth. The pieces of salt were hung from the tripod by a sling made of thin pre-sterilized wire and then put on two Bunsen burner flames for one minute. Dombrowski himself wore sterile clothing and rubber gloves, as if in an aseptic surgical operation.

"A retort containing a liter of culture solution was brought up to the salt in such a way that the salt would be suspended in this solu-

tion. The suspension was then burned through and the retort closed with a stopper which, together with the rim, had previously been sterilized by a Bunsen flame. The culture was kept at 40 degrees. When the culture had begun to grow, it was developed into a pure culture by the usual bacteriological methods," reports Dombrowski, explaining that in preliminary experiments the flaming time was determined.

"Pieces of salt that had been introduced into a fresh suspension of vital *Pyocyanus* were able to be sterilized in 45 seconds. The surface of the pieces of salt weighing about 300 grams was thereby rendered germ-free. They produced a saturated solution when dissolved in one liter of culture. This is particularly important in the raising of organisms that flourish in a salty environment."

While this work was being done, Dombrowski put out plates for airborne germs. If any of these showed a growth, he tested them for salt tolerance and biochemical properties. His tests always gave results proving that these bacteria were not identical to the ones found in the salt.

The first Paleozoic microbe that Dombrowski found in the mineral water springs at Bad Nauheim and which he later isolated from the Permian salt beds (*Pseudomonas halocrenae*) was "reanimated" by placing it in fresh nutrient broth. Though the tests worked in only 20 to 30 percent of the attempts, some

Survival of bacteria shows exacting adaption to environment

of the simple beings began to germinate and increase.

Since the bacteria that became active had no similarity to the bacteria in the air of the laboratory, Dombrowski was reasonably sure he had been successful in bringing back to life only those organisms isolated from the salt beds.

"What makes Dombrowski's work of special interest," observes Prof. Engelbert Broda, a physical chemist at the University of Vienna, "is that a suitable host for investigating the longevity of micro-organisms is not easy to find. Most of it is liable to recent contamination, since very little material has been sealed in a container impervious to penetration by recent micro-organisms."

During the last seven years Dombrowski, who teaches at Freiburg University's Balneologie and Klimaphysiologie Institut, has been keeping his Paleozoic bacteria alive. He has made film slides and motion pictures (magnified some 5,000 times) to show the world's oldest living beings to fellow scientists at lectures in all parts of the world.

According to Prof. Adolf Papp, paleontologist at Vienna University who has followed the Dombrowski work carefully, the bacteria found by the German research scientist can only be but a narrow sample of the bacterial fauna living in those periods. He feels that Dombrow-

ski's bacteria are the "fortunate ones" adapted to the exacting demands imposed on their ability to survive and that their survival over this enormous length of time bears witness to the phenomenal strength which must be innate in life.

Dombrowski's line of research has had to come to a full stop with the 500- to 600-million-year-old bacteria, for, as far as modern geology can tell, there are no older salt deposits.

Dr. Heinz Dombrowski, father of 5,000,-000 year-old bacteria, with microscope.



Stay young with ions

The Fountain of Youth has eluded man for centuries. Instead, a shower of ions may be a way to revive his lost energies.

by Tom W. Hill

WITHIN a few years, persons who find themselves being slowed down by old age may be able to take a series of painless air-ion inhalation treatments that will renew their youthful energies and abilities.

By taking such treatments regularly, they could extend the enjoyment and usefulness of their lives substantially. The possibility that scientists will be able to achieve such rejuvenation is seen in the results of experiments conducted recently by Drs. R. A. Duffee and R. H. Koontz at Battelle Memorial Institute, Columbus, Ohio.

The Duffee-Koontz experiments were performed on two groups of laboratory rats. Half of the rats were quite young—3 months old; the other half were retired breeders, 14 months old, which is slightly past the prime of life for the strain of rats used.

The purpose of the experiments was to find out how the performance of the rats would be affected when they were exposed to differ-

ent types of atmospheres and subjected to stress. The variables in the atmospheres were the number and polarity of air ions (i.e. molecules or groups of molecules of air carrying an electric charge). Some of the rats from each age bracket were housed in a chamber containing normal air, while others were kept in a fairly high concentration of negatively ionized air and a third group in positively ionized air.

It has long been known that beneficial effects may generally be expected from the inhalation of air that contains a substantial excess of negative ions. Similarly, a sizable excess of positive air ions will generally have harmful effects on animals and humans. All the air we breathe contains *some* ions but the concentration is usually only about 800 to 1500 ions per cubic centimeter of air. On most days slightly more than half of these are positive ions, but in certain weather the negative ion count can go up and, for a while, the negative ions may outnumber the positive. There is a theory that we feel especially exhilarated on days when the negative

ion count is higher than usual.

The equipment used in the experiments at Battelle Memorial Institute produced much higher ion concentrations than we find in natural air. In one chamber the level was kept at 290,000 positive ions per cc of air, with no negative ions. In another chamber the concentration was 140,000 negative ions per cc, with no positive ions. In the third chamber, which served as the control, the level was kept at 600 positive and 600 negative ions per cc, to approximate normal air.

The performance of the different groups of rats was tested in a water maze, through which the animals had to swim in order to reach a comfortably heated box. The water in the maze was 9 inches deep. It was also moderately cold and therefore the rats had ample incentive to swim as fast as they could in an effort to find their way out of the

maze to the comfort of a warm box.

As might be expected, under normal atmospheric conditions the young rats learned the maze much more quickly than the older animals. Actually, the old rats could swim just as fast but their "startle-reaction" was slower and they tended to be confused during the first few trials and to make more mistakes than the young rats. Accordingly, the old rats were very much slower than the young ones on the first couple of trials.

A striking difference appeared, however, in the performance of the rats that had been living in a negatively-ionized atmosphere. The old rats that had been inhaling negative ions learned the maze much faster than the untreated old rats. Their average time for the first run was only 11 minutes, 40 seconds, compared with a slow average score of 40 minutes, 56 seconds for the old

In the middle of the test maze, the rat in foreground is paddling as fast as he can to get through the maze filled with cold water to a heated box. This "Channel" swim is part of an experiment to find out if negative ions accelerate animal learning processes.



rats in normal air. By the second trial the ion-treated old rats had cut their score to below that of the young rats in normal air. Although negative ions seem also to have improved the performance of the young rats slightly, the researchers considered this improvement to be too small to be significant.

In another experiment they took a group of rats which had been inhaling positive ions for 18 days and put them in a negative ion atmosphere. This group showed an exceptionally high degree of improvement in learning, which opens a question as to whether there may be special benefits in changing ion polarity.

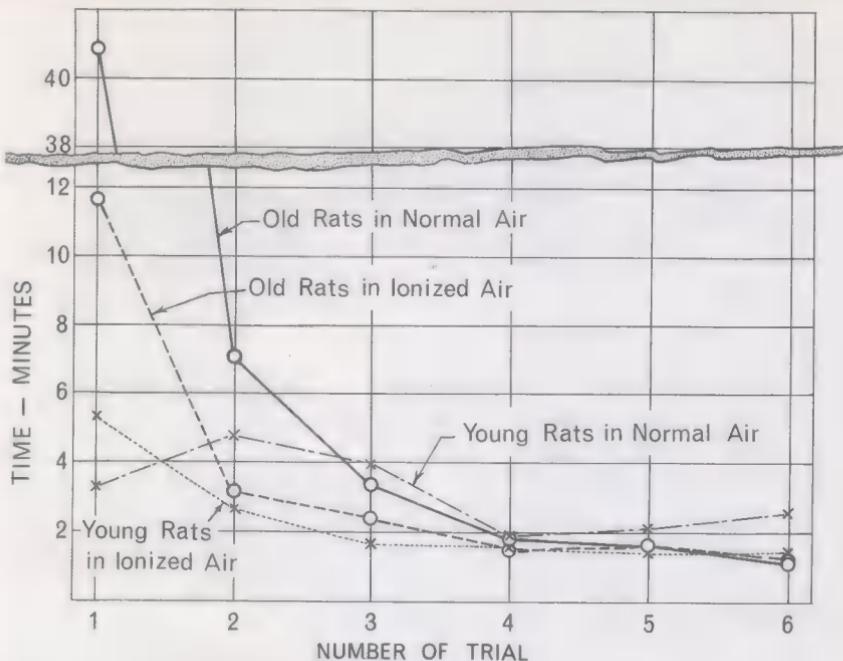
Their demonstration that negative ions improve the learning ability of old rats much more than that of young rats has special significance for scientists because it confirms results reported in 1959 by Drs. Juliana Jordan and Boris Sokoloff of the Southern Bio-Research Institute at Florida Southern College. Although certain details differed in the two sets of experiments (different ionization levels, different animal ages, etc.), the experimental procedures were basically the same and they got results that were in agreement with each other.

Scientists generally will not accept one researcher's experiment as definite proof of what it aims to prove unless and until one or more other researchers try substantially the same experiment and obtain substantially the same results. In the last few years several scientists,

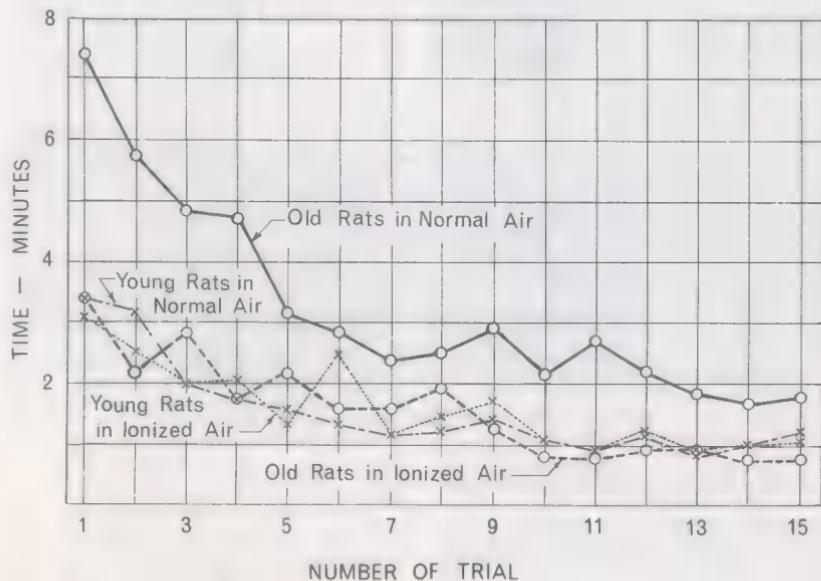
using refined techniques and improved equipment not previously available, have confirmed each other's experiments demonstrating certain biological effects of atmospheric ions. But the work of Drs. Duffee and Koontz with old and young rats happens to give the first confirmation of the earlier findings at Florida Southern College concerning the effects of ionization on animal learning. We can say that there is now proof that negative air ions have a markedly beneficial effect on the learning abilities of old animals.

What does this mean for human beings? The process of aging is generally the same in both animals and man. Psychologists tell us, for example, that man's learning ability reaches its maximum in the late teens and early twenties, declining by about one percent per year after the age of 25. So it is reasonable to assume that negative ion inhalations would improve the declining learning ability of aging humans, just as it improves that of old laboratory rats.

Until several experiments are conducted with both old and young humans, no one will know the answers to such questions as: (a) how pronounced an effect negative ions will have on the process of aging in humans; (b) what ion concentrations will work best; (c) to what extent the switching of polarities will increase ion effectiveness; (d) how long the beneficial effects of negative air ion inhalations will last (e) how frequently and for how long treatment should be given.



The Duffee-Koontz Study (above) corroborates prior Jordan-Sokoloff tests (below), which found that negatively-ionized air considerably improves the learning ability of old rats more than that of young rats. This may have exhilarating results for aging humans.



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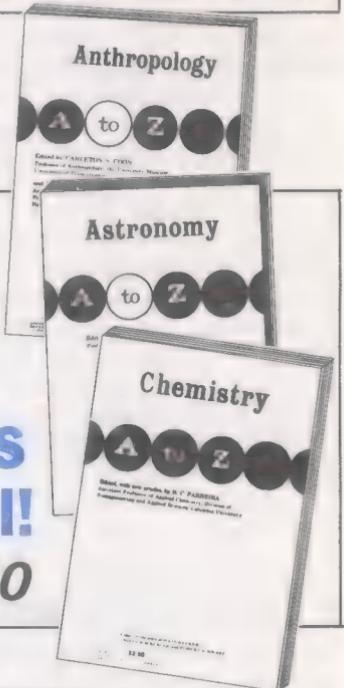
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CBS-TV Photos

For years Campbell Norsgaard has lovingly photographed his back-yard world of insects.

Nature in your back yard

IN the wooded areas surrounding his Englewood, N.J., home, Campbell Norsgaard has spent fif-

teen years photographically exploring a world that is familiar yet surprisingly unknown to us—the world



Lower left: With his daughter Melody as a helper and her pet crow as an onlooker, Norsgaard films termites in a rotting log. Left: Melody is as unafraid of moths as the moths are of her. These colorful insects were raised from cocoons in cages. Above: Norsgaard focuses on moth clinging unheedingly to a nearby branch.



of insects. The patient devotion of this amateur naturalist has produced film records of insect activities that never before have been adequately recorded.

Norsgaard's work was the subject of "The Hidden World," one of a series of television specials produced for the National Geographic Society and shown on CBS-TV, Dec. 13, 1966. Other specials will follow.

Melody Norsgaard, the photographer's 19-year-old daughter, who often helps in his work, is symbolic of an important aspect of Nors-



gaard's personal philosophy. He believes that a vitally important part of young peoples' understanding of life is missing if they grow up without benefit of first-hand knowledge of the workings of nature.

Neighborhood children, alone or in groups, regularly visit the Norsgaard "back yard," where they are enthralled by the photographer's projects in progress.

These have included a wire-mesh aviary, where he raises moths and butterflies from cocoons, a decaying log that feeds a colony of termites, a wooden tray full of ant lions and numerous flagstone-covered nests of other assorted creepy-crawlies.

"Study nature," Norsgaard declares. "Nature alone today teaches responsibility and the respect we must feel for others." And as he shows, you needn't go farther than your own back yard to learn this important lesson.

Insects like this common butterfly are seen with fresh eyes in Norsgaard's photos.

©National Geographic Society



I prescribe . . .

. . . for backaches

by Joseph D. Wassersug, M.D.

IN treating backaches I may prescribe rest or corsets or physiotherapy or medicines or surgical operations or whatever else I believe may prove helpful. I try to start with the easiest, least costly procedures and move into the more involved treatments only if the patient fails to obtain prompt, steady and satisfactory relief.

Sometimes, all the patient needs for relief is a few aspirin tablets; sometimes, it takes major surgery on the spine, pelvis or abdomen. It is often hard for the doctor to know when he first examines the patient just where his plan of treatment will ultimately take him.

The back is beset with a multitude of problems that may bring on acute or chronic discomfort. Disease of the intervertebral discs, congenital deformities of the spine, slight differences in the length of each leg, poor posture, obesity, some diseases of the pelvic organs, and



even duodenal ulcer may cause backache. The list is long, almost endless.

It is easier to understand the mechanics of the back if one first compares it with a bridge. Each leg is a pillar that supports the *pelvis*; the *sacrum* (a wedge-shaped bone in the pelvis) is the keystone of the arch. Riding on the sacrum are 24 thick irregular bones that are piled upon each other (with a softer cartilaginous intervertebral disc in between) like a child's building blocks. Of these 24 bones, 7 are in the neck (*cervical*), 12 have ribs attached (*dorsal*) and 5 are in the lower back (*lumbar*). Heavy muscles, front and back, help hold these bones erect.

The bones that lie on each side of the sacrum are the *iliacs*. Since the sacro-iliac joints, right and left, can be easily strained and are also susceptible to chronic wear and tear, it is no wonder that *sacro-iliac* problems are so commonly a cause of backache.

Furthermore, since the sacrum has to support the *lumbar* spine (and all the bones above, too), one can understand why the *lumbo-sacral* joint and the lower lumbar joints are also frequent trouble spots. Arthritis of the lumbo-sacral joint and sacro-iliac joints consequently are probably the most common causes of backache, especially in older persons.

Nature apparently designed the spine for four-footed animals. If man would only stop this nonsense of walking erect and return to walking on all fours as his remote ancestors did, he would probably get rid of most of the causes of his backaches. But man is a perverse animal that one can hardly expect him to be sensible in this respect. Therefore man will remain a biped and will suffer the consequences.

It is best to consider the spine in its five main anatomic areas: *cervical, dorsal, lumbar, sacrum* and *coccyx*. The sacrum is formed by the fusion of five or six bones into one dense triangular wedge. Through some of the openings in this bone branches of the sciatic nerve and other important nerves travel to the leg and pelvis. (The coccyx is a vestigial tail formed by four or five bones that are rather loosely held together. They rarely cause backache unless injured or badly deformed.)

Pains in the neck (cervical spine) are usually not considered backaches by most people but, in truth, many are. The neck is an especially important part of the spinal

column because the skull with its vital sense organs balances delicately upon the neck bones as a melon being juggled on top of a seven-segmented pole. Almost any malfunction of the neck can cause pain not only locally but also in the upper back, shoulders, scalp and even forehead because of abnormal pressure on the delicate cervical nerves. Just how varied neck problems are can be illustrated by the following actual case histories.

Martha S., a thirteen-year-old girl, had persistent pain in her back and neck for over a year especially in the morning when she got up. Her parents had had her X-rayed, studied by a nerve specialist, examined by a bone specialist, tested for new glasses, all without any relief.

"How long have you had ■ foam rubber pillow?" I asked.

"About one year," Martha replied.

"Get rid of the pillow," I ordered, "and get a small firm pillow instead."

The parents were skeptical but they followed my advice. A day later the pain was gone. The soft foam pillow had not adequately supported Martha's neck muscles and so the muscles had tightened during the night into a painful spasm. The "prescription" for a firm pillow was all Martha needed.

Virginia was ■ sixteen-year-old high school student. She was fairly tall and slightly round-shouldered. For several months she complained of pain in her back and her neck,

and I tried treating her with a variety of sedatives and analgesics. When she failed to improve I sent her to a bone specialist. He phoned me a few days later.

"You've got to get this girl's mother off her back," he told me bluntly. "She's putting her daughter under too much pressure to get high grades in her school work. Her mother's 'on her neck'—and it hurts."

Tactfully I tried to inform Virginia's mother about what the bone specialist had ordered. I explained how neck muscles could go into spasm both under emotional stress and under the prolonged strain of study. I urged that there be a more "relaxed" attitude at home. This good advice proved more effective than any of the medicines that I had previously prescribed in this case.

Surgical cure

Frank O. was a fifty-five-year-old salesman whose neck pain came on suddenly the morning after he won the championship in his bowling league. He noticed that the pain was much worse whenever he moved his neck or turned it from side to side. Thinking that he might have sprained his neck, I prescribed the usual regimen of rest, heat, massage, aspirins and muscle relaxants.

When he failed to improve I ordered neck X rays. They were negative. I then tried phenylbutazone, corticosteroids and cervical traction. The pain persisted. What was even

more disturbing was the weakness in the left upper arm and the just barely noticeable wasting of the muscles in the left shoulder girdle.

Suspecting a ruptured disc, I referred Frank to a neurosurgeon who hospitalized the patient for further studies including a myelogram. Although ruptured discs occur most commonly in the lower back they can occasionally arise in the neck. An ordinary X ray may not pinpoint this condition but a myelogram does.

Frank was operated upon a few days later and the ruptured disc was found pressing on the nerve roots. The disc was removed and Frank recovered completely. Surgery had succeeded where medicines and physiotherapy had failed.

Pains in the dorsal spine are commonly due to poor posture in younger persons and arthritis in older individuals. The student, secretary, accountant, draftsman and all others who work over a desk need a comfortable desk and chair, good lighting, freedom from drafts (including air-conditioners that blow on them) if they are to avoid dorsal backaches.

I, therefore, try to get a good medical history. What does the patient do? How does he do it? Could he be chronically straining his back without being aware of it?

A seventy-eight-year-old retired school teacher came to my office recently complaining of not only backache but pain under his ribs on the left side. "It's just like the pleurisy I had twelve years ago,"

A soft pillow or a too-short right leg can give one a backache

he told me. "I rubbed this liniment in but I must have burned my skin. It's festerin' now." I examined his back. There was a cluster of sores just to the left of his mid-dorsal spine and several similar clusters along the two ribs.

The diagnosis could be made at a glance. It was shingles. The backache which had preceded the rash by a few days was typical. I prescribed some codeine and aspirin and told him the pain would gradually ease off and the rash would fade. Rubing liniment had merely aggravated the condition, but had not caused it. Shingles is due to a virus infection of a nerve or group of nerves. It may cause severe pain whenever it occurs.

Harry was a mechanical engineer who complained frequently of a dull gnawing backache which he believed was due to his work. Every night after supper he took a couple of aspirins and felt a little better. On a routine annual chest X ray, I noticed there was a mild curvature of the dorsal spine. Investigating further I found that the spinal curvature was due to the fact that his right leg was $\frac{3}{8}$ of an inch shorter than his left.

I prescribed a $\frac{3}{8}$ of an inch lift for his right heel. It took Harry a little while to get used to wearing the heel pad but it cured his backaches. The unequal length of the legs had created a slight tilt of the

pelvis which, in turn, resulted in a slight curvature and strain of the dorsal spine.

Aside from general reassurance, advice, and consultation with experts, I treat backaches in four basic ways: thermal, mechanical, chemical and surgical. Since most backaches are in the lower back or lumbar spine and pelvis these four methods apply especially to these areas.

By thermal, I mean heat. A hot water bottle or an electric heating pad almost always brings some relief. Soaking in a warm tub helps many patients but not all. If the tub is too small and the patient's position in it is cramped, it may add insult to injury. If the heating pad is too hot there may be nasty burns. Lying flat on one's back on a heating pad with a large pillow under the knees and a smaller pillow under the head (to relax the spine muscles) is often therapeutic. Since I am not an expert in diathermy or deep heat devices, I don't fool around in the field. When I think a patient needs some exotic device I refer him to a specialist.

By mechanical I mean massage, corset, strapping with adhesive plaster, traction, and sometimes, manipulation. Massage should be gentle, frequent, persistent. A massage treatment by inexperienced persons two or three times a day at home is usually better than expert treat-

ment once a week. Rubbing alcohol or talcum powder can be used for massage and is probably as effective as the much advertised liniments and greases. A firm, flat mattress is often therapeutic and so is a good bed board.

Adhesive strapping is more helpful in acute cases than in chronic conditions. A fat elderly woman cannot be strapped successfully because the adhesive cannot be solidly "anchored" to layers of fat that slide over each other. A firm, often specially made, specially fitted corset is preferable in these cases.

Cervical traction can usually be carried out at home if the patient is given specific directions. A traction device that hangs over a door can usually be purchased for less than fifteen dollars. Traction of the legs and pelvis is best carried out in a hospital by experts.

Manipulation of the spine is highly regarded by osteopaths and ignored by most orthopedic surgeons. The truth is that both viewpoints are extreme. Manipulation does help some cases, is useful in many and harmful to some.

When the spine is manipulated it is best to be sure that it is done by someone who is so well trained that he can recognize its limitations and be cautious. The manipulative techniques that are valuable in the treatment of the injured football player or professional wrestler may be a menace in the chronic disease ward or in the arthritic unit of a general hospital.

By chemical treatment, I mean

drugs and medicines. Usually I start with aspirin or other salicylates. In most cases they are still the best and safest. The average adult patient can usually take two aspirin tablets four times a day without any danger. When aspirin is inadequate, I prescribe phenylbutazone, indomethacin or corticosteroids. Since these drugs may cause annoying or serious side effects I keep these patients under close observation.

Sometimes muscular relaxants such as meprobamate and carisoprodol (and a variety of others) are helpful especially when combined with salicylates. Since these medicines may cause drowsiness in some persons, I caution these patients about driving or working in hazardous areas.

For patients who need surgery, I refer them to the appropriate specialist. If the backache is due to a growth or tumor in the womb or pelvis, I refer to a gynecologist or general surgeon. If the problem is a disc or some other serious condition, I urge the patient to see an orthopedic or neurologic surgeon. Backache problems may be so involved at times that the patient may have to be studied by blood specialists, stomach specialists, and experts on breast diseases.

The human back is an intricate mechanical structure many of whose secrets are just beginning to be revealed by special techniques such as those of cine-radiography (X-ray movies) and complicated bio-chemical analyses.

PLEASE EXPLAIN



KFS Photo

Freighter sinks just outside Egypt's Alexandria harbor where it struck submerged rocks during storm.

Where do sunken ships go?

Do ships sink all the way to the bottom of the sea, or does the pressure hold them up in deep water when they go down so far?

An object will sink in water, if it is denser than water. The density of water is one gram per cubic centimeter, and such substances as rock and metal are considerably denser than that. Ships built of huge masses of steel float because they enclose large volumes of air. The average density of the steel and other construction materials, plus the volume of air inside the ship is less than that of water. If through some accident, water is allowed to enter the ship, the average density of construction material plus the

contained water is greater than that of water alone and the ship sinks.

As it sinks, the object is subjected to greater and greater pressures. At the surface of the ocean, the pressure (due to the atmosphere) is 14.7 pounds per square inch of surface. Thirty-three feet below the surface, the weight of that depth of water adds another 14.7 pounds per square inch to the pressure. Each additional depth of thirty-three feet adds another 14.7 pounds per square inch, and at the bottom of the deepest known portion of the ocean floor, the pressure is about 1,100 times atmospheric pressure. That comes to about 8 tons per square inch.

Such high pressures have no effect whatever on "holding up" sinking

objects. The pressure is exerted equally in all directions, down and sideways just as much as up, so that the object continues sinking quite oblivious to any rise in pressure.

But there is another factor. Pressure will compress water, increasing its density. Can water become so dense as a result of great pressure that objects will stop sinking and float on the denser deep-sea water?

No! The compression effect is very small. Even at a pressure of 8 tons per square inch, the density of water rises only from 1.00 to about 1.05 grams per cubic centimeter. If a solid had a density of 1.02 grams per cubic centimeter, it would indeed sink beneath the surface waters and come to a floating halt about three miles down, then sink no further. Ordinary structural materials, however, have densities considerably higher than 1.05. Aluminum and steel have densities of 2.7 and 7.8 grams per cubic centimeter respectively. Metal ships would sink to the bottom of the ocean's deepest abyss without the slightest chance of floating.

But suppose the ocean were deeper still. Would a time ever come when a bar of aluminum, say, might reach a maximum depth? The answer is still: No!

If the oceans were about 42 miles deep (instead of seven at most) the pressure at the bottom would rise to some 45 tons per square inch and the density of water to about 1.3 grams per cubic centimeter. At that point, however, the water would no longer remain liquid but would

be converted into a solid substance called "Ice VI." (Ice VI is denser than water, whereas "Ice I"—ordinary ice—is less dense than water.)

Aluminum, therefore, and any other substance with a density greater than 1.3 grams per cubic centimeter would continue falling through any depth of ocean just as long as the water of the ocean remained liquid and would eventually come to rest on a solid surface of either ordinary ocean bottom or Ice VI. Liquid water would never become dense enough to float solid aluminum, let alone solid steel.

—Isaac Asimov

What is a hybrid rocket?

A hybrid rocket combines both liquid and solid chemical propellants in a single engine and offers the potential of providing the advantages of economy, performance, reliability and safety over present all-solid and all-liquid engines.

The only problem with hybrid rockets is that they haven't been built yet—they are entirely theoretical. A step toward the production of such rockets, however, was recently undertaken by United Technology Center, with the beginning of work on a \$1,027,000 contract to demonstrate the hybrid's technical feasibility.

The program is expected to fur-

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nish data and technology which would permit the fabrication and testing of a 200,000-pound-thrust engine. Computer data which the program will develop would permit design for engines in the one-million-pound-thrust class and greater.

How does food become energy?

In all animals including man food is converted into useable energy in mitochondria, microscopic structures within the living cell. By an as yet little understood process, the energy contained in food is converted chemically to "organic" phosphates bonded chemically to ATP (adenosine triphosphate), essentially the only organic molecule that can store and transport the energy that makes life possible.

The body uses energy by breaking the loose chemical bond holding the "extra" phosphate radical in the ATP molecule. When the phosphate is released the ATP becomes ADP (adenosine diphosphate) and the energy that had held the larger molecule together is freed to power other life processes.

Within the mitochondria are even smaller structures called cristae. These are the actual sites of the mitochondrial metabolism. In electron microscopes, the cristae are seen to be composed of a baseplate, a stalk and a knob, looking something like short dandelions. The knob which looks vaguely like the blossom of a dandelion on its short stem, is thought to be a single protein molecule.

Recently, Dr. Robert E. Beyer an associate professor of zoology at the University of Michigan received a Public Health Service grant to study this basic mechanism of life.

Though Beyer is not concerned with applications of his discoveries, he says that precise knowledge of the chemical process could lead to a number of practical developments. Among those are treatments for thyroid diseases and metabolic disorders, regulation of the heat output of the body, and control of weight.

The researcher said detailed knowledge of mitochondrial metabolism might make it possible to reduce the body's efficiency in converting food to energy, a boon for compulsive eaters. But he doubts it will be possible to increase food conversion efficiency, however, because the human body already is a rather efficient energy converter. "The energy conversion of people is more efficient than that of either the steam engine, or the internal combustion engine," he said.



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THE HUGH DOWNS COLUMN



Aspirin, Liquor and LSD

ONE of the characters in *The Big Sky*, by A. B. Guthrie, Jr., asks a question of a friend during a philosophic discussion: Why didn't God make man so that he felt all the time as he did when he had half a tin cup of whiskey in him?

Eric Fromm has called alcohol the prop of Western civilization. For the individual (and he is legion) whose anxieties form a nagging irritation to his psyche, a blast of booze is a momentary surcease, alcohol being a solvent for anxiety. For a small percentage of people, the existence of alcohol is a problem. They are called problem drinkers or alcoholics, although it has been argued that the problem personality may act out his hostilities, including homicide, or find his

own destruction even without alcohol.

A fully mature person tends to do without alcohol, having no need for it and finding even occasional social drinking more of a drag than a life.

But great numbers want it and can handle it, and apparently a free people will reserve the right to decide for itself—within a framework of moderate regulation—when and whether to use alcohol.

Experiments to suppress it completely in this country resulted in disaster and were followed by a full flowering of organized crime. Prohibition and punitive legislation were simply unworkable.

If liquor is so cherished and so much a part of our culture, why

then *aren't* we built by nature to feel constantly intoxicated? Is it perhaps because the 'good' feeling of intoxication is a negative one?

Suppose great masses of people suffered constantly from systemic headache.

Suspension of responsibility

One of Guthrie's characters might then ask, "Why didn't God make a man so he feels all the time like he does when he's just taken three aspirins?" The assumption here is that mankind suffers headache by nature. Aspirin, by momentarily suppressing the pain, creates an illusion of positive well-being. The analogy in the case of liquor is that the average man's sense of responsibility to himself for survival, and to his fellows as a social animal, carries considerable anxiety, which is suspended by the momentary reduction of inhibitions when the forebrain is swabbed soothingly with distillations of the fermented grape and grain. The anxiety is the systemic headache of the psyche. It is normal but not healthy. The tensions of life are inevitable—anxiety about them is not. It comes from immature and compulsive methods of dealing with tension, from unnecessary, early-acquired guilt and other factors attributable to lack of total emotional health.

Are there parallels to be found in the uncontrolled use of psychedelic chemicals?

LSD, the most potent of these, is

now 28 years old and has been used in experiments for 23 years. The use of other mind-altering drugs may be older than civilization.

If the mind-altering properties are a potential force for 'good'—bringing liberation, religious ecstasy, therapy, creative insights—why were we not designed by nature to go through life in a perpetual psychedelic state? Why are we not born with 'widened' minds? Guthrie's character speaks again: "Why didn't God make a man so he'd feel all the time like he does on a pleasant LSD trip?"

Ultimate Truth (whatever it is and assuming it exists at all) may be extra-logical, and during feelings of strong conviction, drug-induced or otherwise, we may transcend logic (as well as individuality and time and space). But in the world we live in, our continuance is best furthered by a mind not so much widened as shaped to function along logical guidelines, shutting out or inhibiting certain data, allowing attention and concentration to be directed through responsibility to personal and social needs.

Anxiety-reducing "trip"

"Insights" may be sparse under this set-up, but maximum survival is put first.

Now again, if the responsibility chafes, if the anxiety it produces is a continual abrasive annoyance, if escape is an urgent need, or if security is at a high enough level so that the individual feels he can trade off

Proper knowledge of LSD, not punitive laws, can regulate its use

a little inhibition for more insight, a psychedelic trip can have appeal. (The direction of a trip is more capricious and less predictable than the effect of a few drinks, however. Even the same person can experience very different results from the same dose of LSD. Attempts to control the trip apparently increase the chances of unpleasantness.)

Now does a free society reserve the right to decide for itself when and whether to use psychedelic chemicals? Is prohibitive and punitive legislation unworkable? Will it create a flourishing black market and a new wave of organized crime?

Certainly the need for some sort of regulation is almost universally acknowledged. The quarrels are between reactionaries, who want to make it go away by lumping it with narcotics and consigning it to the underworld, and those who, like poet Alan Ginsberg, think it should be dispensed along with chewing gum in coin machines.

The great danger posed by the LSD problem is that these two extreme viewpoints will work together unwittingly and bring about the abandonment and loss of an important research tool. The visionary will so tarnish the reputation of it with his adolescent attacks on the Establishment that he will help the reactionary in his efforts to legislate it out of existence.

Legitimate researchers will be embarrassed to probe further into LSD and it will become a dirty word. This has happened before: Hypnotism got a 50-year setback from vaudeville stunts and parlor charlatans. Medicine came to feel it was simply not respectable and, until recently, turned its back on it.

LSD: Key to insight?

It would seem there are no shortcuts. No pill or chemical can ever really contain Salvation, or Maturity, or Truth. But very often discoveries do contain the opportunity to learn and to grow, and sometimes offer momentary relief from the pain, physical and mental, of existing—a chance to set the burden down and catch our wind.

Aspirin and alcohol are proven palliatives. LSD, properly checked out and thoughtfully used, may prove to be much more. We may yet find in it much to comfort and enhance the individual human, and we may find the key to closing the gap between the runaway pace of our technical progress and the snail's pace of our social change.

The mind of man, complex enough to duplicate 'chunks of the sun' in thermonuclear devices, may now be able to widen itself into the insight necessary to prevent forever the use of these devices against men.

QUIZ



UPI

This layer of detergent foam in Lake Erie provides a dramatic and dismaying illustration of just how polluted our nation's once ample supply of fresh clean water has become.

... and not a drop to drink

by John and Molly Daugherty

NASA's Michoud Assembly Facility in New Orleans, which generates chemical waste in the assembling and testing of Saturn 5 and Saturn 1 first stages, prevents contamination of surface and sub-surface water and mineral resources and protects marine life by a deep-well disposal method. It deposits chemical waste into a sand strata 6,600 feet down. A second well will be ready this spring. Tragically, few cities have gone this far to prevent pollution and today it is a grave national problem.

What do you know about keeping water clean?

1. Rivers clean themselves if
 - a. They are not overloaded
 - b. The current is not too slow
 - c. There is enough rain
2. Compared with people, fish are
 - a. Less sensitive to water pollution
 - b. More sensitive to water pollution
 - c. Equally sensitive to water pollution
3. The possibility of wide-spread poisoning by lead pollution is greatest from
 - a. Air
 - b. Water
 - c. Vegetation
4. From air, water and food, the concentration of lead in the bloodstream average only $\frac{1}{4}$ part per million. To reach the threshold for lead poisoning, the concentration has to increase
 - a. Two times
 - b. Four times
 - c. Ten times

5. The Ruhr River system in the West German industrial region handles pollution problems so well that fishing, swimming, and unhampered navigation are possible. The unique method used along the Ruhr is to

- a. Prohibit all dumping of industrial wastes and sewage
- b. Charge industries and towns a high levy in proportion to the amount of pollutants each sends to the river
- c. Fine and jail all violators who add wastes to the Ruhr River

6. Our country has plenty of water but not plenty of clean water because much of our water is dirty from sewage, salt, silt and industrial wastes. In the Egyptian Sudan, where water is scarce, water is stored in

- a. Underground caves
- b. Trunks of hollow trees
- c. Open ditches

7. The surface of the earth covered by water is about 71 percent, but the water of the oceans is too salty for direct use. Our greatest resource of usable water is

- a. Surface reservoirs and lakes
- b. Connate waters
- c. Ground water

8. When salt that is used to melt ice off of sidewalks gets on the surrounding grass, it may kill the grass because of

- a. Osmosis
- b. Hydration
- c. Capillary action

9. Sea water salt content averages 3½ percent. About 1,000 towns in the United States use water containing 1 percent salt, yet the human kidneys can excrete no more than

- a. 1 percent
- b. 2 percent
- c. 3 percent

10. On the coastal plains of semi-arid Israel, a plant physiologist found that

certain plants grew twice as fast when covered with

- a. Mist
- b. Fog
- c. Dew

Answers:

1—a They are not overloaded. Overloading a stream with silt breaks the food chain by cutting off the sunshine the green algae need for photosynthesis. Green algae eat substances formed by the bacteria and give back to the water oxygen which bacteria consume. Bacteria use sewage in a river as food, and, in turn, protozoa eat bacteria. When the food chain is broken, other processes of decomposition take over, and the river putrifies.

2—b More sensitive to water pollution. Fish live in water but get their oxygen from the air dissolved in water. In pure water the oxygen content is about 15 parts per million. Approximately 6 to 10 parts per million is necessary for healthy fish. Badly polluted water may have 0 parts of oxygen per million.

3—c Vegetation. In France, recent analysis of many vegetables shows that certain plants concentrate lead from air, water or soil. A plant can multiply by a large factor the concentration of lead in water by storage within the plant. Near Denver, the U.S. Geological Survey found 3,000 parts of lead per million in water-washed grasses. In Canada, geologists found vegetation with high lead content near highways. Americans ingest about 400 micrograms of lead every day from air, water and food.

4—a Two times. This increases the

concentration to $\frac{1}{2}$ part of lead per million—not a comfortable margin for safety. Some sources of this lead are gasoline additives, food-can solder, lead pesticides, and the vast accumulations of lead stored over the years in paints, alloys and glazes.

5—b Charge industries and towns a high levy in proportion to the amount of pollutants each sends to the river. This method makes keeping pollution to a minimum economically profitable. An assay measurement of the biochemical oxygen demand of organic wastes on the water supply determines the charges. Overloading with waste material soon depletes the oxygen supply in the river. At Essen, solid wastes are dried and used for fuel in a power plant.

6—b Trunks of hollow trees. Thousands of these trees may be found along roads. In some sections the trees are registered, and the amount of water stored is noted. The trees hold from 300 to 1,000 gallons of water. After being filled, they are sealed with wet clay to keep the water clean.

7—c Ground water. The ground water reserves are reached by digging down to the water table, which lies above impervious layers of rock below. The quantity of ground water exceeds all the surface waters of reservoirs and lakes. For example, the South High Plains of Texas covering about 6,700 square miles contain ground water estimated five times the water of Lake Mead at Hoover Dam. Of course, ground water level as measured by the water table varies with the use and recharge by rainfall and rivers.

8—a Osmosis. Water can pass through cell membranes into the roots

of vegetation. But if the water is salty, the flow is reversed—water flows from the grass to the concentrated salt water surrounding the roots. The dehydration soon kills the grass. Salt invasions of the vegetation covering natural water-sheds sets up a cycle of destruction ruining vegetation, causing erosion, silt-ing streams, and destroying the drainage system.

9—b Two percent. Concentrations larger than 2 percent cause dehydration of the body and eventual collapse. Heart patients often need a salt-free, low sodium diet. (Salt is sodium chloride—NaCl.) The Public Health Service has checked the drinking water in several thousand towns for sodium content. Any water having over 1,000 parts of salt per million is defined as saline. Sea water generally averages 35,000 per million.

10—c Dew. On clear cloudless nights plants like corn or squash radiate back to the atmosphere most of the energy they received from the sunshine during the day. The radiation so cools the plants (and the ground) that the dew point of the air nearby is reached. The leaves can absorb the dew directly, and it reaches the roots—a complete reversal of the usual process. Plants protected from dew did not show this increased growth. Dew is unpolluted.

Score yourself

9—10 right—You're as clean as pure water on this quiz.

4—8 right—Your answers are slightly polluted.

0—3 right—You know what you're drinking anyway!

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SILVER Ingots, 99% pure, 3 oz. t. \$7.—; 3 ingots 3 oz. each \$20.—, 1 avdp. lb ingot \$32.—; 4 one lb ingots \$120.—Weight/Fineness certified. Shonback (Silver-Smelting), Box 22168, San Francisco, Calif. 94122.

15 LINCOLN Cents before 1930 \$1.00. Bonus catalog. Rays Coins, Streator, Ill. 61364

PETS—BIRDS, CATS, HAMSTERS, ETC.

LIVE Seahorses, marine specimens aquarium supplies. Illustrated catalog 15¢. Marine, Box 248-104, Dania, Florida.

GERBILS—Fact booklet, \$1.00. 20 Simple Experiments, 25¢. Details: Robinson, 940-D Gen. Stuart Dr., Virginia Beach, Va. 23454.

RABBITS, FUR BEARING ANIMALS

MAKE Big money raising chinchillas, guinea pigs, rabbits, mink or pigeons for us. Free information. Keeney Brothers Farms, New Freedom, Pa. 17349.

MONEYMAKING OPPORTUNITIES

PIANO Tuning quickly learned with an approved home study course. Diploma granted. Send for free booklet "Your Future Security". American Piano Tuning School, Gilroy, Calif. 95020.

\$45.00 THOUSAND. Home addressing! Longhand, Typewriter, information, stamped, addressed envelope. Brewster, Box 1626-SD, Clearwater, Florida 33515.

MAKE Money with your camera: Write to Camera Arts Exchange: Box 101-D: Hollywood, Calif. 90028.

MUSIC AND MUSICAL INSTRUMENTS

WORLD Wide Love booklet w-poems, music, photo & letter of John F. Kennedy. \$1.25 per copy. White's Music Publisher, 6527 S. Stewart, Chicago 60621.

POEMS wanted for new songs and records. Send poems. Five Star Music, 6-C Beacon, Boston 8, Mass.

SONGWRITERS Wanted, send lyrics or songs. Tin Pan Alley Records, 1650-SD Broadway, New York 10019.

PLAYER Piano rolls—Hundreds of selections. Send for catalog. Melodeon, Wexford, Pa. 15090.

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, GUMMED LABELS

BUSINESS Cards embossed; 1,000 \$4.10, postpaid. Goodall, 68-D Joost, San Francisco, Calif. 94131.

PERSONAL

SEMI-SKINNERIAN Utopian community being planned. Gerald Baker, Oberlin, Nebraska 68762.

CHRISTIAN Tracts, print & give at each house. Free samples. 33905 Victoria Blvd., Hampton, Va.

RESURRECTED Billions will farm ocean bottoms when seas removed by coming whirlwind! Free. Write: Harvest-SD, Jefferson City, Mo. 65101.

LETTERS

TO
SCIENCE DIGEST

Ancient gold?

The diggings described in "The Archaeology Story, Mystery of an Engineering Marvel" (Oct. '66), are surprisingly similar to some modern California terrain. They are identical to the tailings of a gold dredge in low-yield placer mining. I am sure that these people (the ancient Columbians) did not have a 100-ton floating gold dredge, but I believe they had the same purpose. I suggest that they systematically dug up the river bottom, and processed the gravel for gold.

Probably, a group of men would dig a two-foot wide trench, passing the dirt out to sorters and panners. After the gold was extracted, the residue would be piled back into the trench behind the diggers. To prevent

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HAWAII Remails, 25¢. Fast, confidential. 1509G-4
S. King St., Honolulu, Hawaii 96814.

WANTED—MISCELLANEOUS

MERCURY—Gold-silver-platinum for cash. Circu-
lar. Ore assays. W-Terminal, Norwood, Mass.

MISCELLANEOUS

WINEMAKERS Catalogue and pkg. of Winery
Yeast 25¢ postpaid. Kraus, Box 451-R, Nevada, Mo.

THE Magic money book. Biblical formula. Details
10c. Dynamic, Box 1776, Yorktown, Virginia 23490.

PROTECT Your family from unwanted callers. In-
stall in outside doors inconspicuous "one way" wide
angle viewer. Precision ground optical lens gives
amazing clear view of 2 or 3 persons. Simple to
install, fits all doors. Be safe. \$3.95 each. Money
back guarantee. Send check or money order. Ray C.
Ricke, 2023 Lucas, Dallas, Texas 75219.

INTRODUCTORY Offer 4 blades including stainless
steel. Send 10c stamps or coin. Alex Sanders, 516
5th Ave., New York 10036.

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dress including Zip Code
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Box # 654, New York, N.Y. 10019

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the processed gravel from spilling into the future adjacent trench, it would be piled as high as possible in the center. This undoubtedly explains the mounded ridges.

It is well-known that many of these rivers carried gold. Canadian and American interests were dredging in nearby rivers as early as 1909, and leaving the same type of tailings. Didn't the flying archaeologists notice them?

The next time they visit this area, I suggest that someone carry a gold pan.

FRED E. SANFORD
Mountain View, California

"Irresponsible"

In "Late Science News" (Oct. '66) there is this statement: "Meanwhile a U. of California, Berkeley, research consultant reported on a three-year study of flying saucer clubs. Their members' education, physical and mental health, he said were below average."

The above statement is irresponsible without also presenting the clubs involved and figures involved in the study. Did the researcher study the National Investigations Committee on Aerial Phenomena or the Aerial Phenomena Research Organization. Or did he study only the small UFO cults? I think his time could have been better spent studying the UFO itself.

The statements by this researcher needs to be amplified and presented fully. Let's be just about this.

R. J. MACDONALD
Oakville, Ontario
CANADA

Amplification appears on p. 61 of the Dec. '66 issue.—Ed.

Another jump

The story "Would You Have Jumped?" (June '66) was very interesting and reminded me of another conductor who was not as lucky. Long ago in Arkansas, conductor Jack Caperton on a north bound freight made a run to get on the caboose and missed. The station was crowded because his freight was ahead of a passenger train.

The conductor's pants were torn, and he was bruised and bleeding. The freight was braked up and stopped at the station and he was helped into the caboose.

As the freight moved slowly away, he shouted to everyone on the platform, "All of you come back next Sunday. I do this every time I come by here."

B. MATHEWS
Shreveport, La.

Careful reporting

The article "ESP Enters the Laboratory" by Flora Rheta Schreiber and Melvin Herman (Oct. '66) is a good example of thoughtful and careful reporting in an area where the temptation to be a bit more flamboyant is great.

MONTAGUE ULLMAN, M.D.
Director of Psychiatric Services
Maimonides Hospital of Brooklyn

Most interesting

I thought your article "Your Hidden Life Asleep" (Sept. '66) was one of the most interesting articles I've ever read on the subject.

A2/C WILLIAM BEARD
Kessler AFB, Miss.



Pictorial Parade

Coldest spot on earth

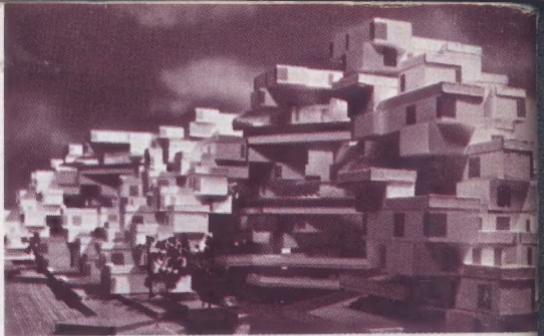
THE silver cannister nestled in the web of pipes and wires (above) is the coldest spot in the world at the moment. Dr. Dafydd Phillips, right, one of a team of British scientists who developed the device, says, "It is within a tenth of a degree of the temperature of outer space—minus 273 degrees Centigrade—which is as cold as it is theoretically possible to get. It is almost ten times colder than the North Pole." The "super-freezer," which operates by using two isotopes of helium, should prove useful in aerospace research.

In the

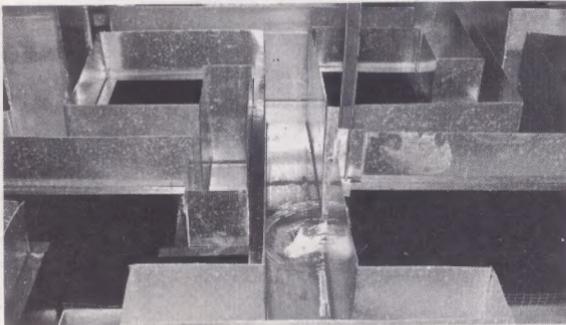
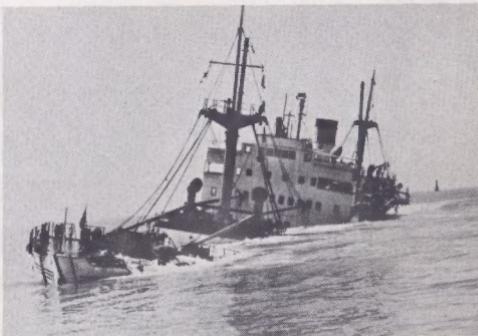
Like it or not, virtually all of us cities. What is the city to be like? Science Digest has this vital question in the first series of in-depth reports. This 16-page section begins on page



No fooling, electric autos may really be coming back. Detroit's big three are worried, and interested. Find out just what is going on and why on page 9.



Will a ship ever stop sinking before it reaches the ocean bottom? Would it stop sinking if the ocean were miles deeper than it is? America's leading explainer, Isaac Asimov, tells what would happen and why on page 87.



A dose of negative ions will help an aging rat learn a water maze more quickly. It may also help aging humans regain their slipping vigor. See page 74.



The Loch Ness Monster may not be a myth. New investigations have accumulated impressive evidence and theories that seem to fit. See page 20.

The trouble with man is that he is stubborn and walks upright instead of on all fours as nature seems to have intended. So he gets backaches. Learn how a doctor treats this almost universal ailment. In the article starting on page 82.



Computers are helping to chart the moods and outline the treatment for hospitalized mental patients. Story begins on page 15.